THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXV. No. 1671.] LONDON, MAY 21, 1895. [47TH YEAR. PRICE 6d.

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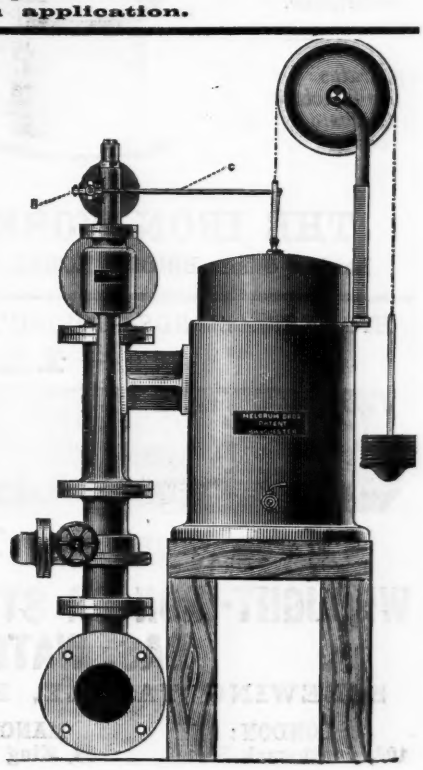

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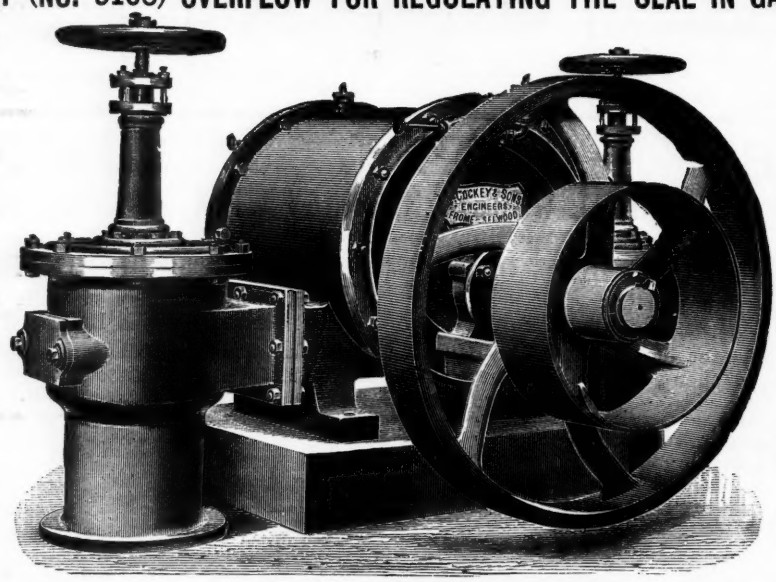

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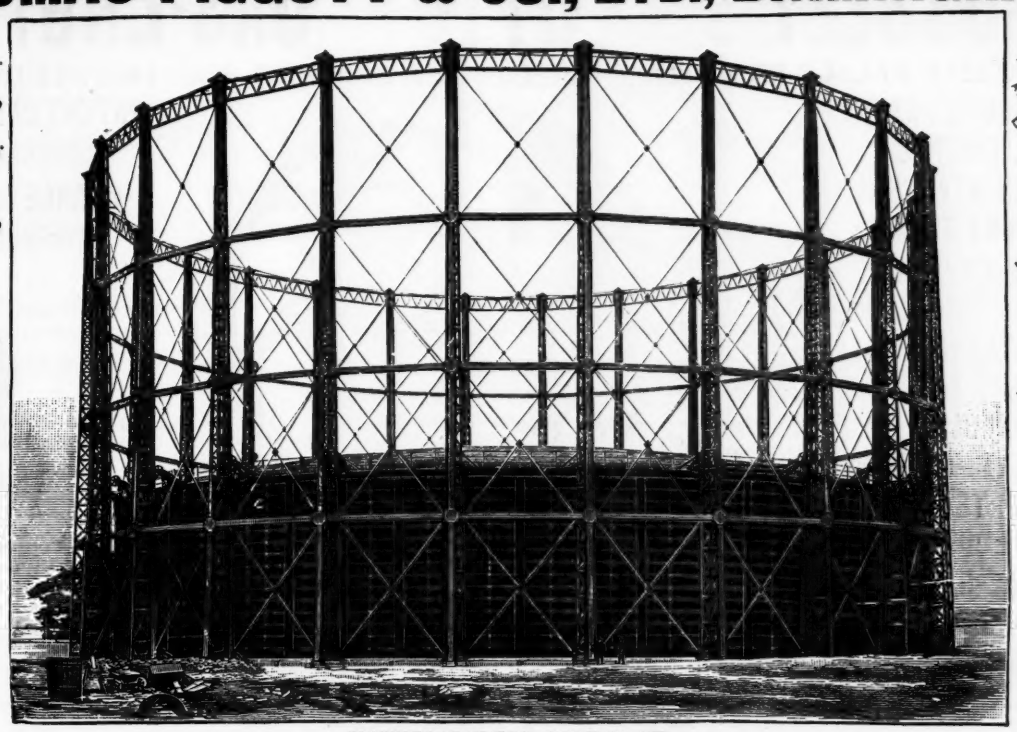

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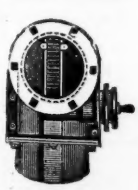

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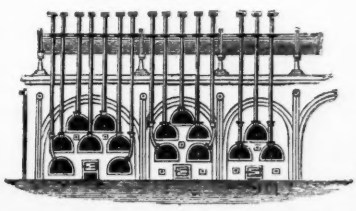

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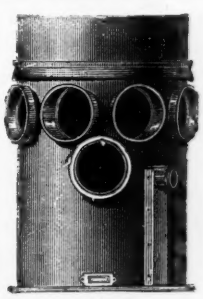

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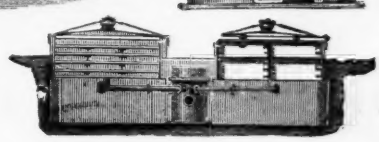

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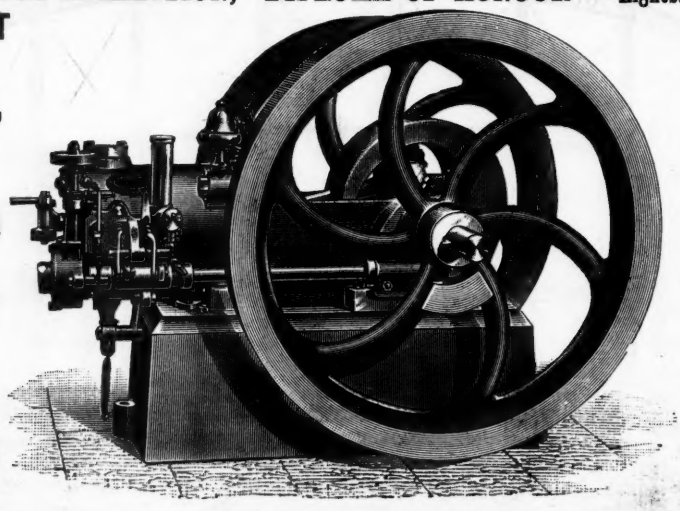

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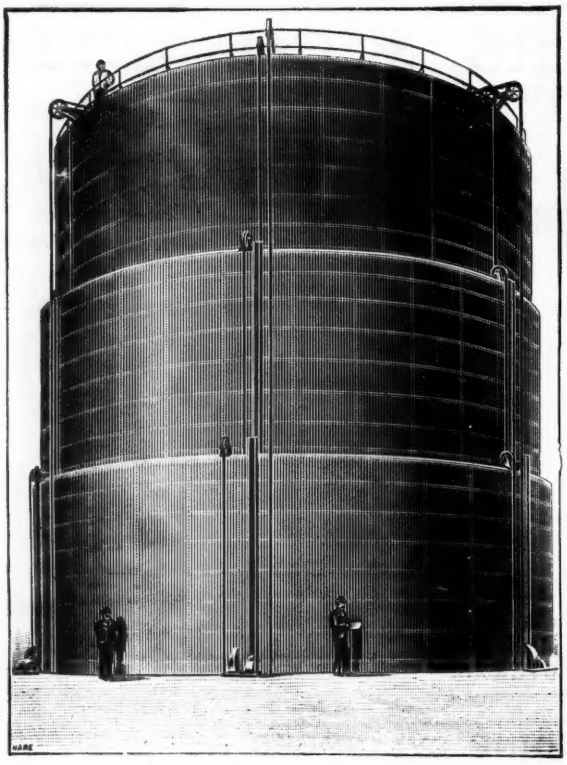

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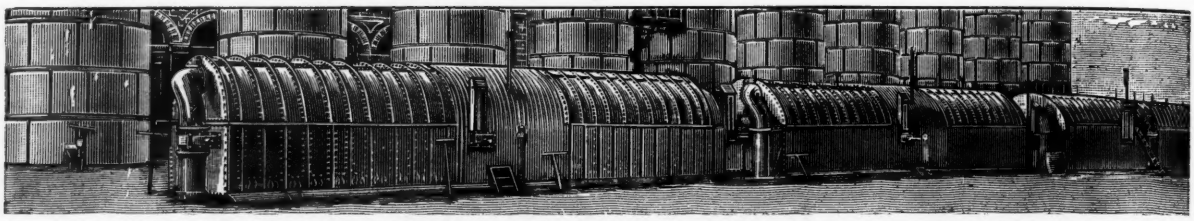

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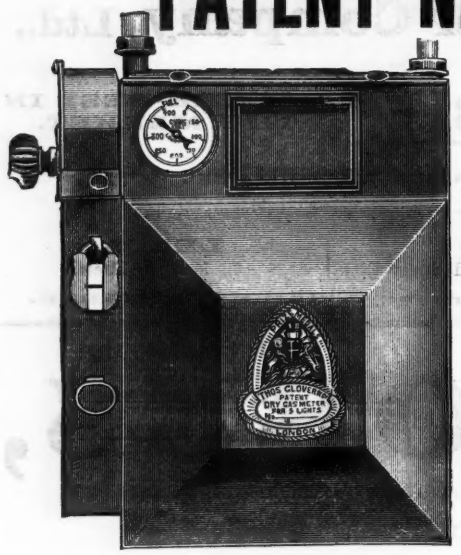

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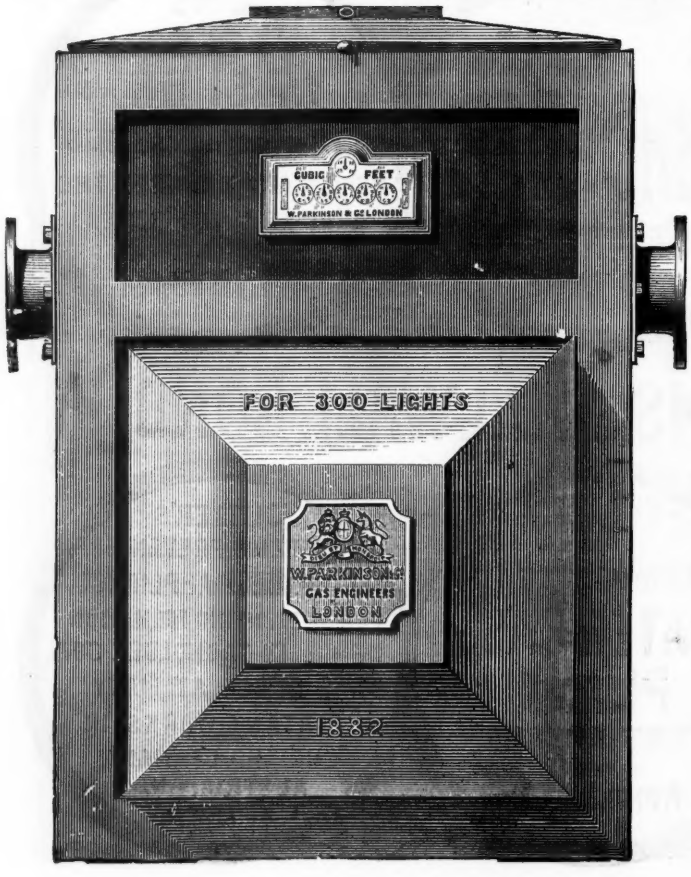

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EDITORIAL NOTES.

Carburetted Water Gas at Tottenham.

WHEN we last mentioned in these columns the prospects of carburetted water gas in the United Kingdom, it was in connection with the announcement that plant for the manufacture of this description of gas had been ordered by the Manchester Gas Committee. We remarked at the time that there was no available information respecting the capabilities of carburetted water gas for meeting the requirements of small works. This was written in ignorance of the contents of Mr. A. E. Broadberry's Gas Institution paper on the Tottenham installation, which is reproduced in another column, and will be found, on perusal, to amply justify the high appreciation already expressed by us of its merits as a contribution to the literature of the subject. The author of the paper comes of a stock not greatly given to seeking "advertisement;" but the industry at large knows enough of the Tottenham management to be able to place implicit confidence in all statements relating to technical matters emanating from this source. This it is as well to premise, because it must be said of the paper now under notice that it sets up the advantages of carburetted water gas higher than any previous statement, and proves that, in the particular medium-sized gas-works in question, this description of gas is actually made in bulk equal to nearly 40 per cent. of the total output. Here is sufficient testimony at once to the cheapness and the excellence of the manufactured article. It is only necessary, after this, for us to at once admit that the condition of ignorance respecting this aspect of the carburetted water-gas question to which we confessed only now three weeks ago has been removed. Mr. Broadberry's paper is so clear and full, that any gas manager in the kingdom can ascertain from it whether in his own case it would pay him to adopt the same system. There was nothing in the discussion to touch the key of the author's main position. At the same time, it looks very much as if it was the contemplation of the data given in the paper as to the illuminating power derived from the oil gasified in this plant, which inspired the President of the Institution with those doubts as to this being the most economical method of using oil which are expressed in his Inaugural Address.

It is, of course, impossible to separate the carburetting from the bulk-producing qualities of such a plant as Mr. Broadberry describes; and the practical convenience of being able to carry on the two operations simultaneously, as the gas is wanted, is likely to outweigh any slight consideration of saving of oil that should be secured by its gasification in a separate and independent plant. It seems desirable, however, for the time being at any rate, to keep well before the minds of technicians interested in the general subject, the facts that the generation of water gas and its carburetting are distinct processes, albeit consolidated in the most popular pattern of plant, and that the superior economy of this combination is not yet established beyond the reach of criticism. We do not desire to undervalue the argument from the superior popularity of the improved Lowe type of plant in America, upon which Mr. Broadberry lays such stress as a justification for preferring the same description of apparatus for Tottenham. It is quite true that as it was in England with the Otto gas-engine patent, so it was in the United States with the Lowe system. While the trade in it was a monopoly, all sorts of rivals took the field, only to disappear when the trade was thrown open; and the plan that had been favoured by law was also recognized, in the event, as the fittest to survive. All the same, as we have already observed, there is no necessary connection between success with carburetted water-gas plant in the United States, and the successful operation of such plant in the United Kingdom. The two sets of environment may be, and apparently are, satisfied by the same pattern of plant. This is greatly to the credit of the plant; for it might just as easily have been the other way. As it is, we are able to congratulate the gas manufacturers of the United Kingdom on the possession of a "second string," the worth of which some of them have already proved.

Mr. Broadberry writes to us to-day to answer the objection raised to the addition of an excess of carbonic oxide to town's gas, which must result from the use of carburetted water gas in bulk. His long quotation from Dr. Louttit's

laboratory records is interesting; but we doubt if these statements will be regarded as settling the question now, any more than they did at the time they were first published. He treads upon dangerous ground, moreover, when he refers to the repeal of the anti-carbonic oxide law of the State of Massachusetts as proof that this was "a foolish and unnecessary hindrance to a beneficial and "convenient system of artificial lighting." Everybody knows at whose instigation the law was repealed; and everybody also knows that considerations of public safety are not allowed in the States to stand in the way of the interest of powerful corporations. We think it not in the slightest degree doubtful that, if some similar statistics of fatalities from inhaling illuminating gas to those which are collected annually by the Massachusetts State Board of Gas and Electric Light Commissioners were once to present themselves in this country, the gas to which they might be ascribable would fare badly. When our public authorities are made acquainted with anything like these returns, it will be useless to talk about rabbits and bell jars. The best argument for Mr. Broadberry to use in this regard is to be found in his table of gas analyses, which shows that at Tottenham, with an admixture of 35 per cent. of carburetted water gas, the town gas only shows 13·8 per cent. of this constituent. This is not an alarming proportion. For the plant he uses, however, the initial content of the unpurified water gas in carbonic oxide—27·4 per cent.—is low.

To return, for the sake of one point, to the paper. It was remarked in the discussion that Mr. Broadberry obtained a high proportion—6 per cent.—of carbonic acid in his water gas; and he admitted the impeachment. It seems to have been wholly removed by purification before the combined gases were sent out; and this circumstance must not be overlooked in connection with the claim that 22·38-candle gas is made with a consumption of 3·34 gallons of refined kerosene oil per 1000 cubic feet of gas produced. Now, there is hardly a gas manager in England who works under independent examination for illuminating power, who would not regard with uneasiness the prospect of having to deal in a combined gas, such as that of Tottenham, with more than double the proportion of carbonic acid usually found in coal gas. Lime is perhaps plentiful at Tottenham; but even so, the cost of purification must be more than for coal gas—say, half as much again. This is not a great matter, perhaps, in some places; but in others there would be nothing for it but letting the carbonic acid go, and using more oil to "square" it. Mr. Stelfox said, in his Gas Institute paper of last year, upon this very point: "Where the retention of the impurity "only means the use of a very small extra in oil, or the "reduction of the illuminating power from (say) 24 to 22 "candles, the question assumes a vastly different appear-"ance." As a matter of fact, we believe that Mr. Stelfox only takes out the sulphuretted hydrogen by oxide. It is rather to be regretted that nobody said anything at the meeting about the effect of a large admixture of water gas upon the appearance of the ordinary coal-gas flame.

Mr. G. E. Stevenson on the Gas-Engine.

THE paper on the "Modern Gas-Engine" read by Mr. G. E. Stevenson at the meeting of the Institution of Gas Engineers, and given in the JOURNAL last week, merits attentive perusal, as being a masterly statement of the facts of a subject which cannot be otherwise than of commanding interest for gas engineers, albeit it does not readily lend itself to discussion in public meeting. We are glad to recognize in the new "scavenging" Crossley-Atkinson motor, a substantial advance upon what has hitherto been regarded as the best practice in gas-engine design. It is the more satisfactory because there seemed to be some reason to fear lest the style of motor to which it has been applied had arrived at the climax of its mechanical development. It is also gratifying to learn that the bounds which for years limited gas-engines of the Otto type to what, in comparison with steam motors, was a small size and power, have been, and are continually being, further left behind. As we read Mr. Stevenson's statement, it gives the impression that the lead in increasing the size and power of gas-engines is with firms other than that which has held the Otto patent monopoly for so long; while the "scavenging" modification of the Otto engine already mentioned is directly attributable to the advantage so wisely taken of the opportunity, afforded by the expiration of the master patent, for infusing fresh blood into the Crossley organization.

Without going, on the present occasion, into the merits of these developments and modifications, it is permissible to deduce from the facts a moral about the operation of patent right. The legal protection afforded under this name to the patentees and manufacturers of a meritorious mechanical invention is, in a way, of inestimable benefit to the community, as offering an inducement of proved sufficiency to tempt men of genius and capital into the hazardous and toilsome paths which lead, through persevering, well-directed effort, to technical success and financial reward. Dr. Otto and Messrs. Crossley deserved the success and the reward which nevertheless drew upon them the envy, and in a sense the enmity, of the rest of the world of mechanicians. The proverb says, however, that there should be reason in all things; and it is inevitable that, when a protected speciality has attained a high, or extreme, degree of success, would-be competitors should arise with the aim of sharing in the profits of the new business. In cases where the protection of the envied speciality is perfect—as it was in that of the Otto engine—so that there is no hope of the profits of its exploitation being shared by outsiders, however enterprising, there is nothing for the latter to do but to honestly rival what they cannot copy or infringe. The number of rivals that cropped up during the lifetime of the Otto master patent was considerable, and some of them displayed great ingenuity in the attempt to circumvent what could not be got over—the impregnable Otto patent right. At length, in the fulness of time, this protection expired; and no sooner was the Otto system made common property, than its superiority, previously contested, was confessed by the cessation of all attempts to make gas-engines upon any other principle.

Here is where the case of the public against the holders of master patents finds its best opening. How much effort, time, and money would have been saved if the Atkinsons, Tangyes, and others who have for years been striving to rival a system which they knew to be the best, had been enabled instead to bring their ingenuity and resources to bear upon the perfecting of this system—of course, under terms which would have secured a reasonable recompense to the first and true authors of the principle! The suggestion is neither novel nor free from objection; but now, when the history of the gas-engine has repeated that of the steam-engine, and compression of the charge has gone the way of the crank, the reflection that there are two sides to the absolute rule of patent right again recurs.

The Eastern Counties Association Meeting.

THE members of the Eastern Counties Gas Managers' Association met at Sudbury, Suffolk, last Wednesday, under the presidency of Mr. C. W. Grimwood, who is a good surviving specimen of the now scarce, but once fairly common, species of "gas man" known as the lessee. Mr. Grimwood stands in this relation to the Sudbury gas undertaking, as well as to several others in different parts of the eastern counties, where some things have not changed as they are apt to do in more bustling and growing regions. Mr. Grimwood's Inaugural Address was practical; and the same description may be given of the only paper read at the meeting, which was contributed by Mr. Drage, of East Dereham, and consisted of a collection of observations suggested by the writer's experience in the construction of new works at this place. Such a paper is naturally open to much discussion; and there was a good deal of talk round several of Mr. Drage's points, which are not remarkable for much besides their familiarity to such an audience. The next meeting of the Association is to be held at Wisbech. The proceedings terminated with a dinner, which was well attended by members and friends of the Association. We desire to congratulate Mr. Grimwood and the Honorary Secretary of the Association (Mr. H. Wimhurst, of Sleaford) on their recovery from the sickness which prevented the meeting from being held at the usual period in the earlier spring.

Can a Patentee Do What He Pleases under His Patent?

IF we revert once more to the case of *The Incandescent Gas-Light Company v. Cantelo*, it is only for the purpose of drawing attention to a point in Mr. Justice Wills's ruling which possesses general importance to patentees and the public, and has nothing to do with the merits of the particular case. The learned Judge is quoted as having laid down the

law as follows: "The patentee has the sole right of using "and selling the articles; and he may prevent anybody "from dealing with them at all. Inasmuch as he has the "right to prevent people from using them or dealing in "them at all, he has the right to do the lesser thing—that "is to say, to impose his own conditions. It does not "matter how unreasonable or how absurd the conditions "are." Now, with every respect to the learned Judge whose *dictum* this is asserted to be, we venture to remark that plain persons—such as are supposed to be competent to pronounce upon a good many points of patent law—will experience some difficulty in harmonizing this view of the right of a patentee with the well-known limitation of those rights enacted in the Patents, Designs, and Trade Marks Act, 1883. By virtue of provisions which were then new, power was given to the Board of Trade to compel patentees to grant licences. The grounds on which the intervention of the Board of Trade may be obtained are threefold: The first is that the patent is not being worked in the United Kingdom; the second, that the reasonable requirements of the public with respect to the invention cannot be supplied; the third, that any other person is prevented from working or using to the best advantage an invention of which he is possessed. The order of the Board of Trade in these matters can be enforced by *mandamus;* and there is no appeal.

It is not for us to say that these provisions, or any of them, are incompatible with Mr. Justice Wills's reading of the law; but on the face of the question, we should be inclined, by our understanding of them, to demur to his Lordship's declaration of the absolute right of the patentee to impose whatever conditions he pleases upon people who are desirous of using his invention. Let us say once more, for fear of misunderstanding, that this is not a question of Welsbach mantles or royalties, but of the rights of patentees and of the public under the English law. The Act of 1883 merely put into plain language what was understood before as a principle of law, but could not always be enforced by anybody except the Crown—that the grant of a patent is conferred as much for the public good as for the profit of the patentee. Under the old law, a patentee had no rights whatever as against the Crown; and by the present law, although patents are good against the Crown, there is no obligation on the Crown to ask leave of the owner to make use of any patent. But this can be done at the will of the Government; and the compensation allowed to the patentee will be settled in the last result by the Treasury. How this provision might work in regard to warlike inventions need not be particularized. But let us, for the sake of illustrating our own point, take an imaginary case of a patent covering (say) the manufacture of commercial acetylene. Such a process, as we have been told, has a variety of possible developments. The product can be used as an illuminant; but, on the other hand, it may eventually be found useful in the synthesis of commercial forms of alcohol. Suppose now that a powerful syndicate of capitalists, averse, on principle, to the extension of the list of materials from which intoxicating drinks are derivable, should proceed to acquire the master patent for commercial acetylene, with the avowed intent of stopping its production or sale for any other purpose than such as they might approve—would the restriction placed in this way upon the traffic in acetylene hold good in law? According to Mr. Justice Wills, it would. He says: "It "does not matter how unreasonable or how absurd the "conditions are." So far as our understanding of the matter goes, we beg to differ.

Mr. Leo Taylor, F.I.C., F.C.S., has been appointed Public Analyst for Hackney, in succession to Dr. Tripe.

Mr. William Orme has been appointed Manager of the Congleton Corporation Gas-Works, in succession to Mr. W. T. Goodwin, resigned.

The Management of the Salisbury Gas Company.—The recent decease of Mr. T. Hardick, which was preceded only a few weeks by that of Mr. J. Lucas, who had been employed by Mr. Hardick for 42 years, and for the last 32 years had been yard foreman at Salisbury, has necessitated a rearrangement of the staff. The principal changes are the promotion of Mr. Norton H. Humphrys, Assoc.M.Inst.C.E., F.C.S., who has held the appointment of Sub-Manager for the last twelve years, to the post of Engineer and Manager, and the engagement of residents in the city to undertake the duties of collector and office assistant respectively.

WATER AND SANITARY AFFAIRS.

THE inquiry now proceeding before the Hybrid Committee of the House of Commons appointed to consider the Bills by which the County Council seek to acquire the undertakings of the Metropolitan Water Companies, has already brought into clearer light some of the serious issues connected with the subject. What conclusion the Committee may arrive at on any of these points, it would be impossible to say, even if it were proper to make the attempt; yet it seems to come within the range of probability that the County Council, by the ardour of their pursuit, may only defeat their own purpose. Mr. Balfour Browne, in opening the case for the Council, dwelt at great length on the several decisions in Parliament which approved the transfer of the London Water Supply to a public body. Moved by these remarks, Mr. David Plunket, the Chairman of the Committee, stated, for the guidance of Counsel, that the Committee intended to follow the line laid down in the report of Sir Matthew White Ridley's Committee in 1891, and would proceed on the assumption that, in the opinion of Parliament, it was desirable to establish a single public representative Water Authority for the whole of the Metropolis. Mr. Balfour Browne was delighted. If there was to be such an authority, it must possess the undertakings of the Water Companies; and what authority so proper as the County Council! Who should the king delight to honour but somebody who was looking out for it? But Mr. Plunket interposed, and gave the triumphant advocate to understand that he must build no airy castles on this foundation. The Committee simply took the words of Sir Matthew Ridley's report for "exactly what they were worth;" and no further construction was to be put upon this declaration at the present time. It may possibly occur to Mr. Plunket's Committee, as it doubtless will to some other people, that, if there is to be one representative authority to have charge of the Metropolitan Water Supply, the readiest and most reasonable plan would be to create a Water Board or Trust to cover the whole area at present occupied by the Companies. By such a system, the outer areas could be represented as well as the inner circle; and the whole would be welded into one undertaking, subject to the management of a body having nothing else to do. It may be that the County Council begin to see the risk of having such a plan sprung upon them. They are already taking action to lop off the outlying parts, so as to bring the water supply within the limits of the administrative area. Suburban Surrey is thus dealt with; and Mr. Balfour Browne was able to announce on Wednesday that the Surrey County Council had withdrawn their opposition to the Lambeth Transfer Bill. What had been done in the case of Surrey would also be undertaken with respect to Middlesex, Kent, Essex, and Hertfordshire. There is policy in all this; but it is nevertheless a weak device as affecting the interests of a vast population. The outlying Authorities may be anxious to keep the County Council at bay; but a general Commission or Board, created for the distinct purpose of the water supply, might be acceptable, especially if rendered properly representative.

A startling statement was made by Mr. Charles Harrison when under cross-examination by Mr. Pember on Friday. It was that, if the County Council failed to get "what they considered equitable terms, such as were "proposed in the Bill, they would still seek to be the "Water Authority for London." Mr. Pember readily interpreted this as meaning that, if the County Council failed to carry their arbitration clause, they would drop all the Bills, and agitate the question anew. The attitude of the County Council in view of defeat was exhibited in a striking manner in the course of Mr. Balfour Browne's address. If the Transfer Bills were not carried, he intimated that the Council might find it necessary to establish a competitive supply. The Chairman thereupon reminded the learned Counsel that this must be subject to the assent of Parliament. Mr. Balfour Browne expressed confidence that Parliament would not refuse to give consent; and he went on to remark that, if competition were introduced, "it would knock the price of the Company's shares down "to nothing." The learned Counsel further intimated that the Council, by buying up one undertaking, might bring such competition into the Lambeth district as would reduce the revenue of the Lambeth Company more than half, and prevent the payment of interest on their debenture

stock. This kind of contingency has been foreseen, but its probability denied. Henceforth there will be authority for the apprehension. In fact, much that was urged by Mr. Balfour Browne had the appearance of an attempt to frighten the Water Companies into a surrender. If these Bills did not pass, something worse was to come; and the County Council was to be "a menace to the Water "Companies." Such language seems to pass the bounds of parliamentary pleading; and we are not surprised that the Chairman tried occasionally to show its futility. The Companies need make no particular objection, for the more of such bullying the better. It must be a poor cause that has need of such advocacy. The audacity of the learned Counsel has evoked a rebuke from our contemporary *Engineering*, who comments on the "astonishing" statement made by Mr. Balfour Browne, that the inhabitants of London are supplied with "filtered filth," and are using water not fit to drink. We can only suggest that, if the learned Counsel chooses to contradict some of the best chemists and scientists of the day, of course he has full liberty to do so; but nobody need believe him. Perhaps he will promise that the County Council shall supply nectar. But whether the Council is "the best "body" to undertake the water supply of London is yet an open question, and constitutes one of the subjects with which Mr. Pember proposes to deal at the sitting of the Committee to-day.

Early in March, we mentioned that the Finance Committee of the County Council had just presented a report, stating that they had introduced a clause into the Council's Money Bill for this session, authorizing expenditure on capital account for the purpose of acquiring the undertakings of the Water Companies; the redemption of any such money to be extended over a period of "not less than "one hundred years." The mode of proceeding has since been altered; and a separate Bill has been brought into Parliament, instead of a mere clause in the usual Money Bill. In the measure thus prepared, the text of which will be found in another column, the period for the redemption of capital is specified as "not exceeding one hundred "years." The Bill was read a first time at the commencement of last week, and was to have been read a second time on Thursday; but it was ordered to stand over until to-day. In the meantime, there is a difficulty to be encountered as to Standing Orders, owing to sixty years being exceeded as the period for the redemption of capital. The Bill was to go before the Examiners yesterday; and its progress is further intercepted by a blocking notice from Mr. Whitmore, and another from Mr. Boulnois. Should the Bill be read a second time, Mr. Stuart will move that it be referred to the Hybrid Committee. There have been frequent changes in the constitution of this Committee; and now we find its quorum is reduced from seven to five. The Bill to which our present remarks relate is a very short one, though, if carried through Parliament, and afterwards put into complete operation, it would involve very large financial transactions. Perhaps the whole affair will drop through, and the London Water-Works Transfer (Money) Bill of 1895 will come to naught. Certainly, a curious feature in the Bill, as in other documents bearing on the same subject, consists in the employment of phraseology marked by the absence of the word "purchase." The principal Bills are for the "transfer" of the water undertakings; and when this term is not employed, we read that each undertaking is to be "acquired." In the Bill just introduced, the capital is to be employed in the "acquisition" of the undertakings, or some of them. We do indeed stumble upon the word "sale" once in each Transfer Bill; but when the local authority of an outer area is to obtain possession of the works appertaining to the district, that authority has to "purchase" from the County Council. It would seem as if the process of "buying up" the Companies' undertakings was not the ruling idea at Spring Gardens, but rather that of taking possession, and giving the Companies something less than the value of the property in question. The words "transfer" and "acquisition" appear to correspond to the peculiar idea of arbitration which enters into the Council scheme. The fact that the property is to pass into the hands of the Council before it is paid for, or the price fixed, seems to demand a word foreign to the ordinary conception of "purchase," and rather in accordance with the Shakesperian phrase "to convey."

In the columns of *London*, a weekly publication devoted to the interests of the County Council, an attempt is made to show how highly Birmingham is favoured in respect to the charges levied on the consumers for the supply of water under municipal rule. Comparison is entered into with the rates charged by the Lambeth Company, as affording the necessary "frightful example" of what directors can dare to do. Thus we are told that the annual rate charged in Birmingham for the supply of water to a house having a net value of between £40 and £50 is £3; whereas "the charges of the Lambeth Water Company "on a £50 house for a worse supply are over £4." It should be explained that for a £42 house, irrespective of water-closets, the Lambeth Company's charge is barely £2 15s., to which one water-closet adds 12s., and a second water-closet, 6s.—a total in all of £3 13s. As compared with £3 at Birmingham, there is an excess; but if there is one water-closet instead of two, the Lambeth charge becomes £3 7s. The statement, therefore, that the Lambeth Company charge "over £4" for a house "between £40 and £50 value," is not altogether correct; unless we take the higher value of £50, and even then the utmost charge is £4 3s. But Lambeth is not the whole of the Metropolis, though *London* writes as if it were. The charge levied by the West Middlesex Company for a £42 house with two water-closets is £2 2s. per annum, as compared with £3 at Birmingham; besides which the West Middlesex Company allow a handsome rebate to their customers. For a £50 house with two water-closets, the West Middlesex charge would be £2 6s., or 14s. below the Birmingham figure. The East London Company charge £2 10s. per annum for a £42 house with two water-closets, and £2 18s. for a £50 house similarly furnished. In the New River district, the charge under the like conditions for a £50 house is £2 6s. In the Kent district, a house valued up to £45 pays £2 5s., with 8s. for a second water-closet. Without pursuing the comparison farther, we may observe that, on the whole, the London scale of charge for water, even with the extra amount for water-closets, falls considerably below the Birmingham scale, which is held up for the admiration and the envy of the Metropolitan householders.

Mr. J. H. Sheldrake, who has been connected with the firm of Messrs. D. Hulett and Co., of High Holborn, for upwards of thirty years, has recently resigned his position of Managing-Director; and he has joined the De Mare Incandescent Gas-Light Company, Limited, which, we are informed, was successfully floated last week.

Societe Technique du Gaz en France.—The annual congress of this Society will take place in the theatre of the Association of Civil Engineers, Paris, on the 18th prox. and the two following days, under the presidency of M. de Lachomette. There will be the usual banquet on the evening of the second day; and arrangements will be made for some interesting visits.

Death of Herr Kuno.—We regret to learn, through the *Journal für Gasbeleuchtung*, of the death, on the 24th ult., of Herr Rudolph Kuno, the Manager of the Berlin City Gas-Works. The deceased, who had reached his sixty-eighth year, presided at the last annual general meeting of the German Association of Gas and Water Engineers at Karlsruhe. He was much respected by his colleagues; and representatives of the Imperial Continental Gas Association, the German Continental Gas Company, and many other Associations, were present at his funeral.

The Position of the Russian Oil Market.—According to a telegram, dated the 13th inst., received through Reuter's Agency, the *Bourse Gazette* of St. Petersburg has learnt that the Baku kerosene manufacturers have arrived at an agreement for the establishment of a Union with their colleagues over the country. It is formed for the period of four years. After the expiration of two years, it will be open to any member of the Union to propose any modification in the agreement. With regard to the report that the American petroleum ring has concluded a contract with the Union, it is stated that a private understanding of such a nature is quite possible, but that the agreement will not receive any official confirmation.

Manchester District Institution of Gas Engineers.—The spring excursion meeting of this Institution will take place next Saturday, when the members will visit the romantic district of the Peak. According to the programme issued by the Honorary Secretary (Mr. S. S. Mellor, of Northwich), the members will meet at the Central Station, Manchester, and proceed by the Hope, Dore, and Chinley Railway to Castleton, where they will lunch at the Peak Hotel. The renowned Peak Cavern will then be explored; and subsequently conveyances will take the party to Hathersage, *viâ* Hope and Bamford. On the return to Castleton, tea will be served at the Peak Hotel; and Manchester will be reached shortly after eight o'clock. The whole district is full of interest; and, with fine weather, a most enjoyable day should be spent.

THE INCORPORATED INSTITUTION OF GAS ENGINEERS.

PROCEEDINGS AT THE GENERAL MEETING,

HELD AT THE

ROYAL UNITED SERVICE INSTITUTION, WHITEHALL,

MAY 8TH & 9TH, 1895.

Mr. C. C. CARPENTER, Assoc.M.Inst.C.E., President.

PAPERS AND DISCUSSIONS.

In the JOURNAL last week, we published the first four papers read at the above meeting, with a report of the discussion on that by Mr. Geo. Livesey on "Workmen's Funds." We now give the discussions on the other three, together with the papers by Professor Lewes, Mr. A. E. Broadberry, and Mr. J. Husband, upon "Acetylene," "Water Gas," and "Sloping Retorts," with the remarks to which the two first-named communications gave rise.

DISCUSSION ON PROFESSOR LEWES'S PAPER ON "THE WORK OF THE PHOTOMETRIC STANDARD COMMITTEE."

The PRESIDENT, in opening the discussion, said they were under a deep obligation to Professor Lewes for the very excellent paper he had read; and the best way of showing their appreciation of it was by means of an ample debate. For this purpose, he thought it would be most convenient if they took that opportunity to have the mid-day adjournment.

Mr. G. LIVESEY asked permission, as he had to attend a Board meeting, to say a few words before they adjourned. Nothing could, he said, be done on the Committee's report except by Act of Parliament; and he thought their friends might trust the London Gas Companies to see that a proviso should be inserted, fixing the type and construction of the photometer. They would also take very great care that there should be a proviso for burning the gas not at the rate of 5 cubic feet per hour, but so as to give a light equal to 16 candles. His object in rising, however, was more with reference to the gentlemen who had conducted the inquiry. Of course, a number of them were officials; but he must say something about their able Chairman—Dr. Odling. He could not speak too highly in praise of the work he did in connection with the Committee. Had it not been for the great energy, ability, and tact shown by Dr. Odling, there would not have been a unanimous report—perhaps no report at all. He should like to say also that Dr. Russell, the other member appointed by the Board of Trade, rendered very great service indeed. But he must not conclude without adding a word or two about the Secretary. They were very largely indebted to the ability, earnestness, patience, and the great amount of work done by their Secretary in this matter. The satisfactory result of agreeing on a unanimous report was mainly due to those two men—Dr. Odling and their Secretary, Professor Lewes.

The meeting then adjourned for a short time. On the resumption of the proceedings,

Mr. CHARLES HUNT said they might congratulate the Standards Committee upon the conclusion of their long and, he had no doubt, arduous labours; nor need they grudge them the time which had been expended on the matter. Mr. Livesey had mentioned that there was at one time a probability of the Committee separating without coming to any conclusion. Had they expended double the time, it would have been better than to have separated with but a negative result. They might also congratulate the South Metropolitan Gas Company upon their public spirit; and they might venture to hope that the whole expense of the inquiry would not devolve upon them, but that the Government would see their way to paying the cost of it, or failing this, that the other Metropolitan Gas Companies would bear their share. They might further congratulate themselves, as an Institution, upon the effect of the representations which they made to the Committee some time ago. They were impressed with the belief that this was not a question affecting solely the Metropolitan Gas Companies; but that any method of procedure which might be adopted in regard to them must, sooner or later, extend to the Provinces. This was the ground they took in formulating certain suggestions which the Committee were kind enough to receive. Professor Lewes had told him that morning that their suggestions had been carefully considered; and they had evidence of this in the report. He might refer particularly to the adoption of the 10-candle standard. He believed he was right in saying that there was at one time a probability of a 16-candle standard being adopted. What would have been the effect of that? In the Provinces, they knew the quality of the gas varied; and with each variety of gas—whether 14, 15, 16, or 17 candle—there would have had to be a separate standard corresponding to the quality of the gas supplied. They were spared this multiplicity of standards by the Committee's recommendations, which ensured the adoption of a universal 10-candle standard, applicable to all qualities of gas. It was certainly to be regretted that nothing had been done to standardize the photometer; but he trusted this might come in due course—possibly by a combined recommendation of the Companies to be embodied in the Act of Parliament which would be necessary in order to give effect to these proposals. With regard to the last suggestion which the Institution had made, and which Professor Lewes had described as commercially the most important, he was not sure that he could give an unqualified adhesion to the recommendation of the Committee. Their suggestion was that the rate of consumption of the gas should be adjusted, as nearly as practicable, to the maximum efficiency of the burner; instead of which, the Committee recommended that the gas should be burnt at such a rate as would give a light equal to the prescribed number of candles. Perhaps he could better explain his objection by reference to a diagram on the wall, in which were compared the value obtained from various qualities of gas with a consumption of 5 cubic feet, and that obtained with the chimney full of flame. With 17-candle gas, the variation in illuminating power was very slight; and therefore with such gas the proposal of the Committee might be regarded as almost unexceptionable, because it was found that, within sensible limits of variation, there was no important variation in illuminating power. With 16-candle gas, however, the case was very different. A gas that gave the light of 16 candles when burned at the rate of 5 cubic feet per hour, increased to 16¾ and even to 17 candles when burned at such a rate as to nearly fill the chimney. The effect of raising the quality of the gas was practically the same as increasing the rate of burning; and therefore, when the London Gas Companies supplied gas equal to 16¾ candles when consumed at the rate of 5 cubic feet per hour, assuming the recommendations of the Committee were carried out, and the illuminating power brought down to 16 candles, their gas would not be rated at much more than 16¼ candles. It was true, as had been pointed out by Professor Lewes, that there would be a certain advantage in raising the rate of consumption when the gas happened to be less than 16 candles; and perhaps, in one case out of a hundred of those rare cases in which the Metropolitan Companies failed to observe their standard, they might be saved the unpleasantness of a penalty, but it would be at the cost of having the bulk of their gas permanently diminished in value. What was in reality 16¾-candle gas would be known to the public as only 16¼-candle gas. What was 16-candle gas? Was it to be defined as gas which, when consumed in the standard Argand, at the rate of 5 cubic feet per hour, gave a light of 16 candles? If so, then they had no right to alter the rate of burning. If, on the other hand, as the recommendation of the Committee must be held to assume, it was a gas capable of yielding the light of 16 candles per 5 cubic feet when consumed under reasonable and favourable conditions, then they could have no right to do violence to those conditions by reducing the illumination to 16 candles. They ought not to say: "So far may you go, but no farther." It seemed to him that the logical conclusion to arrive at, from the concessions made by the Committee, was that the gas should be burned at the highest rate consistent with economy, or, at all events, at such a height of flame as would secure the least amount of variation when the rate of consumption was altered. Of course, it would be argued against this that it would give the Companies a certain amount of advantage. This might be answered by saying that the Companies were allowed no advantage by the introduction of the standard Argand; and the then Referees justified

it by stating that the Companies were entitled to the use of the best burner for the purposes of testing. If they were so entitled, surely it followed that they were also entitled to the best that this burner could do for them. It might, however, be argued that times had changed—*autres temps, autres mœurs*—and that nothing was to be given to the Companies. Then it was a matter of arrangement. The standard of 16 candles was surely susceptible of alteration under such circumstances. As it stood, the method recommended by the Committee could only be regarded as an empirical one, and not a really scientific method of testing gas. No doubt the Companies knew their own business best. But the bargain did not appear to be a favourable one to them, even from their point of view; while it must be a matter for regret that an opportunity —the fairest that had ever occurred, or that might ever occur during the lifetime of many present in that room—had been lost, of placing the science and practice of gas testing upon a sound, philosophical, and, as he thought, an unassailable basis.

Mr. G. C. TREWBY (London) said he did not know that he could add very much to the discussion. The labours of the Committee were contained in the report and appendix; and it was perhaps rather premature to discuss them until they had the whole of the facts before them. With reference to the last remarks of Mr. Hunt, he might say that his own opinion all along had been that, whatever burner they used, they should develop the full luminosity of that burner. If, for the sake of argument, they did lose a little when their gas was above 16 candles, they would be saved from penalties by the proposed new method of burning; and this was an important point to consider. They did not mind, from a practical point of view, having their gas returned at ¼ of a candle less, if on the other hand they gained an advantage when the gas was apparently a little below the standard. He could heartily endorse all that Mr. Livesey had said with reference to the work of this Committee, and especially the way in which their able Secretary had conducted the numerous experiments. The Committee had been called to account, on one or two occasions, by the JOURNAL OF GAS LIGHTING, with reference to the time they had taken. But if they had been behind the scenes, and had known all that had taken place, and the danger of the whole thing coming to an end, they would certainly have shown a little more consideration. Now that the Committee's labours were over, he hoped the result would be satisfactory to all parties. The question of what the cut-off should be, had received a great deal of attention, especially by the representatives of the Companies, who, of course, did not want to give away more than they could help. He had been in communication with one of their Engineers, who had been taking the illuminating power of the gas for a long time by the 10-candle standard; and he had arrived at exactly the same cut-off (2·15 inches) as the Committee. This was, so far, satisfactory, and in corroboration of what they had done. With reference to the question of payment of the cost of these experiments, when the matter first came up The Gaslight and Coke Company considered that this was not a subject which was confined to the London Gas Companies; and they took the view that, if legislation was necessary, the expense of it should be paid for by the public. Their friends the South Metropolitan Company were so anxious to get a new standard, that they did not allow the question of expense to stand in the way; and he was very gratified at the handsome manner in which they came forward. He only hoped that this expense would be recouped to them either by the Companies and Corporations or by the Government.

Mr. W. W. FIDDES (Bristol) said he knew what the labours of the Committee must have been, as he had personally done a great deal of photometry in his younger days. He felt that the members of the Institution were under a deep obligation to the Committee. It was not a very thankful office to spend the number of hours in a dark room necessary for conducting the numerous experiments, in order to come to the conclusions to which the Committee had arrived. The lines they had taken were those of which he had always been in favour; and he was glad that the results of the investigation were similar to those he had arrived at many years ago.

Mr. FRANK WRIGHT (London) said there had been a considerable amount of chaos imparted not only into standards of light, but in the matter of applying the same to the photometer, and in photometry generally. He would like to say that he did not consider the candle had been at all fairly treated. To get anything like a reliable standard, they must have uniformity of atmospheric conditions. Since he was a lad of fifteen, he had passed an immense number of candles through his hands; and he very quickly arrived at the fact that the light from a candle could be looked upon in the same way as any other gaseous flame. In other words, the wick, like the orifice of a burner, determined the resultant light. About 1872 to 1875, parliamentary standard candles were made with the wick composed of three strands of 17 threads each. But, for some unaccountable reason, known only to the Gas Referees, the wick had been increased until it had become common to find candles with three strands of 23 threads each, and sometimes even more. The late Professor Graham, of the London University, some forty years since, demonstrated that the light from the sperm, stearine, or tallow candle was practically a constant when the height of the flame was kept constant. Owing to a misconception by one of the leading authorities, he (Mr. Wright) some time ago made certain experiments in which the candles were pared down to one-half their original area; and he found that the consumption of sperm did not vary more than one-third of a grain per hour—conclusively proving that it was the wick which determined the consumption.

The PRESIDENT (interposing) remarked that Mr. Wright was travelling beyond the scope of the paper.

Mr. WRIGHT said, with regard to the pentane 10-candle unit, he was glad to see that the Committee had arrived at some definite conclusion; but he did not look upon such a standard in any degree as novel, as for the last ten years his firm had been engaged in making a variable form of the Methven screen, which was capable of being adjusted to give either two, four, six, eight, or ten candles at will. Such instruments, however, did not appear to have been appreciated in England, judging by the fact that their sale had been exclusively confined to certain scientific institutions in America. As to pentane itself, he did not agree with taking such a volatile spirit. Indeed, it seemed to him to be a foolish thing to take for a stable standard one of the most unstable and volatile oils known. On one occasion, he had been called in to rectify the errors in the original pentane standard due to this; and he very quickly found that, until the burner had become thoroughly saturated with heat, so unstable was the gas that the standard would not behave in a consistent manner. He hoped, however, that the introduction of a 10-candle standard might put an end to the confusion that had prevailed in the past.

Mr. J. METHVEN (Beckton) said he was, to a certain extent, personally interested in this subject. They knew he had devoted a considerable amount of his leisure time to the question before the meeting; and for years he had experienced a great amount of pleasure in the investigations he had made on the subject. He thought the Institution had cause for congratulation that the Committee had arrived at the determination they had in this matter. He believed they had done perfectly right; and he had no hesitation in stating that the standard which had been recommended for adoption was one that would prove generally acceptable to gas makers. He believed the effects of the vagaries of the candle, from which they had suffered very much, would be removed entirely upon the introduction of this standard. He looked with some amount of pardonable pride on the result, as being, to a certain extent, the outcome of his investigations. If Mr. Dibdin had been present, he thought he would acknowledge that his idea was taken from the researches he (Mr. Methven) had carried out. He was looking forward to the time when the standard would be legalized in the Metropolis; but, of course, they would have to wait until this was settled by Act of Parliament. Until then, he should continue to use the standard he had employed for years; and when it was compulsory, he should fall in with the views prescribed by the new Act. He might say, however, that, having tested more than one of the new burners, he had not found the same equality to exist as was represented by a paragraph in the paper. This might perhaps be because the care bestowed upon their manufacture was not so perfect as it undoubtedly would be in the future. When the burners had to go through the ordeal of a test by such scientific men as the

Metropolitan Gas Referees, the manufacturers would, no doubt, see that greater care was exercised. In the construction of the burner, special attention would have to be paid to the formation of the holes, so as to produce in each burner a flame of exactly the same width. If the flame varied in width, then undoubtedly the value of the Argand burner would be affected in one direction or the other. Mechanically, perhaps, there was no great difficulty in doing this; but he had tried two of the burners, and they did not agree. With this explanation, he would just like to say that he had every belief that the system recommended by the Committee for adoption would meet with general favour throughout the Metropolis. Referring to Mr. Hunt's remark with reference to the chimney being full of flame, he thought they must have some defined instrument in which to consume their gas. Mr. Hunt's observations showed that the more flame they had inside the chimney, the greater would be the development of light from the same gas. This undoubtedly resulted from having the longer flame inside the chimney, and consequently excluding a portion of the air, which with a shorter flame the burner would induct. It was altogether a question of controlling the supply of air to the flame. Therefore he maintained they must have a burner of fixed dimensions and fixed properties, supplied with a chimney of fixed length to induct a constant quantity of air to a flame of a constant size. If they did not have this, he thought they would introduce an "india-rubber" rule for the measurement of the quality of the gas. It was a subject for congratulation that the Committee, in addition to the recommendation of a standard for testing the gas, had also recommended a means by which the use of the present burner could be made more advantageous to the gas companies and the consumers.

Mr. Lewis T. Wright (London) said it had been the experience of everyone who had been called upon to make tests with the photometer, to find variations which were exceedingly difficult to explain; and it had been the practice to attribute these variations to some deficiency on the part of the candle. He was not going to speak in favour of the candle, because it had been virtually condemned; and there was an old saying about giving a dog a bad name and then hanging him. In his opinion, this was a very cruel maxim; but perhaps when one had given him a bad name, it was even better for the dog that one should hang him. In some countries where very primitive notions of justice prevailed, it was, he believed, the practice to hang a man first, and try him afterwards; and this appeared to be the case with the candle. He should like to demonstrate the existence of some other causes for the variations in illuminating power of which they all knew, and which causes, he believed, were not so fully understood as they might be. They ought to ask themselves whether the other side of the photometer—the gas-flame side—might not be the cause of some of the variations they met with when testing gas of absolutely uniform quality, the composition of which they knew to be the same, in a series of experiments. Very often, when testing a gas of absolutely uniform quality, they found great variations in the illuminating power as given by the photometer. They had many means of checking the constancy of the quality of the gas—by analysis and in other ways; and he wished to point out that the variations they met with in gas which in no respect varied in its composition, were not always due to the candle. The "Instructions" of the Gas Referees were that the gas should be burnt at the rate of 5 cubic feet per hour; that was to say, 5 cubic feet as registered on the meter—not 5 cubic feet reduced to 60° Fahr. and 30 inches of the barometer, but the gas was always to be consumed at the rate of 5 cubic feet per hour as measured on the testing-meter. He would write down on the blackboard the results of some experiments, which he hoped would make his meaning clear—

Rate Corrected to 60° Fahr. and 30″ Bar., Cubic Feet per hour.	Cubic Feet Uncorrected.	Tabular Number.	Candles Observed.	Candles Reduced to 5 C. Ft. per Hour at 60° Fahr. and 30″ Bar.
4·47	5	0·894	11·60	13·00
4·65	5	0·930	14·00	15·05
4·80	5	0·960	15·00	15·60
5·00	5	1·000	16·00	16·00
5·10	5	1·020	17·00	16·60
5·20	5	1·050	18·30	17·40

The results arrived at by the system adopted by the Gas Referees were those shown in the last column. The gas in each case was tested at an observed rate of 5 cubic feet per hour; but, owing to variations in atmospheric conditions, the actual rates of consumption, as corrected to the uniform standard of 60° Fahr. and 30 inches of the barometer, were more or less than 5 standard cubic feet per hour, and the flame consequently more or less large. The "London" Argand was exceedingly severe upon small flames, as the 6-inch chimney in such cases gave an excessive air supply. By testing the same gas under similar conditions, they obtained that variation which, of course, was due to the chimney. He did not think it was possible to have chosen a more unsuitable burner for the purpose of testing gas than the Argand, because it was so exceedingly sensitive to the rate of consumption. Very small differences in the rate gave considerable variations in the illuminating power of the gas. Some flat-flame burners were not nearly so sensitive to changes in the rate of consumption. He should like to mention that, when the gas changed its temperature, the temperature of the water vapour in the gas also changed. Some years ago, M. Brémond introduced a process by which the gas was to be supplied in a desiccated condition; and he claimed that one of the advantages of the dried gas was an increase in illuminating power of 6 per cent. At that time, he (Mr. Wright) made some investigations on the subject, and found that there was obtained by desiccating the gas this 6 per cent. increase in the illuminating power—an increase entirely to be accounted for by the increased temperature of the flame due to the absence of water vapour in the gas. Mr. Methven was far better aware than he of the influence, not of the water vapour in the gas, but of the water vapour in the air; and he had already made this the subject of numerous experiments. The advantage that appeared to him (Mr. Wright) to attach to the proposed new standard was that, whatever variations there might be in the gas-flame to be tested, owing to differences in the hygroscopic conditions, would be equal on both sides of the photometer. The candle and gas flames suffered equally from these variations of which he had spoken; and the candle, being a very small unit, was unsuitable for testing purposes, as being more likely to suffer from variations in the composition of the atmosphere than the larger flame against which it was compared. There was another matter also on which Mr. Methven had rather fortified his (Mr. Wright's) mind; and he should like to call attention to what appeared to be a discrepancy between the paper Professor Lewes had given them, and the report he read at the end of it. In the paper, Professor Lewes told them that they might dismiss from their minds the idea that any error on the part of the operator in the correct adjustment of the flame would be prejudicial to the gas companies. On the contrary, he said that any difference in the flame above or below the standard height, caused by any carelessness on the part of the operator, would be in their favour. The Committee, in issuing the report, had adopted an entirely opposite conclusion to that stated by Professor Lewes.

Professor Lewes (interposing) said he meant within reasonable limits. If they went beyond the range of constant light, they would get diminution.

Mr. L. T. Wright said that this was contrary to what Professor Lewes had stated in his paper. There appeared to him to be a discrepancy between the two statements. He had attempted to make a remark which he believed had been frequently made before in connection with burners of this class. It was said that, within a range of temperature of from 43° to upwards of 70° Fahr., the differences in the flame of the 10-candle standard, due to differences in the saturation of the air with the pentane vapour, had no influence on the amount of light which passed through the slot. Whether or not this was so, time would show. In the meanwhile, having had the advantage of using the new proposed 10-candle standard, he could speak very much in its favour. It was exceedingly simple to work; but he did not believe that, if it were adopted, they would have reached the end of all their photometrical troubles.

Mr. T. S. Lacey (Pimlico) said he had had a great deal of experience in the use of the 10-candle standard—perhaps more than any other engineer, except those who had been on the Committee; and he had made a large number of independent experiments to ascertain what would be the proper cut-off to compare with candles. He came to the conclusion that 2·15 inches was the nearest point, He

thought it was perhaps a little against them; but there were other advantages which would probably make up for that. Variations of temperature were not difficult to produce; variations of the barometer were. Some months previously, he had a gasholder containing 18,000 or 20,000 cubic feet of gas which had been very carefully tested. During the tests, though the temperature did not change greatly, the barometer varied an inch between two days; but he was pleased to say that change of the barometer did not appreciably affect the value attributed to the gas, which was a point that might be of some interest to them. He thought the gas companies would agree that the cut-off arrived at by the Committee was a fair one, and that it would be found that the standard was one that might be depended upon from day to day.

Professor LEWES, in reply, said that, though he should like to talk for an hour or two on the subject, he would cut his remarks down to almost vanishing-point. There had been two or three most valuable suggestions brought out in the discussion; and Mr. Hunt's remarks were perhaps amongst the most valuable. But the question was not as to whether they should burn their gas with a chimney full of flame, or at a rate which should give a fixed illuminating power. The Committee had arrived at what those gentlemen who were interested in 16-candle gas would consider a fair arrangement. When their gas was initially 17 to 17¼ candles, and they calculated back the illuminating value from that, they did undoubtedly lose a very small percentage; but when their gas was nearer 15 candles, they derived an advantage from this method of testing instead of, as in the present case, getting a serious diminution. His view was that, when he had a balance at his banker's, he did not mind having to pay his bills; but when he had no balance, he objected to having bills pouring in upon him. When their gas was 17 candles, gas managers did not in the least mind it being returned at 16·7 candles. All they wanted was to keep well away from the penalty-point. If they had gas at 15·7 candles, it was, under the present system, quite likely to be returned at below 15·5 candles; whereas with the new suggestion, this risk would be practically removed. As to the question of the cut-off, the 2·25 inches, which was at first put forward, had been arrived at by standardizing with the 1-candle unit when this had been set with the eye exposed to the glare of the flame. When it came to be properly standardized, 2·15 inches was fixed upon as the height for the cut-off. The experiments having been made by most careful experimentalists, Mr. Frank Wright's remarks called for no comment. Mr. Methven had done perhaps more work on the subject before them than almost any man who had taken up photometry; and he should very much have liked to see him on the Committee. There was no doubt that the original idea of using pentane for enriching gas, in order to get uniformity of illuminating power, was Mr. Methven's. Whatever Mr. Frank Wright's ideas might be as to the stability of pentane, certainly Mr. Methven first of all brought out clearly the point that, when gas was enriched with it, one could get a uniform illuminating power from the flame; and he thought the extensive use of the new standard would amply confirm this point. Mr. Lewes T. Wright had given the meeting his views on the "capital punishment" of the candle. His own opinion always was that the candle had been a good old servant; and the less abuse they heaped upon its head, in getting rid of it, the better, more especially as he was not quite sure that they might not have to get a good deal more service out of it yet. The interesting figures which Mr. Wright had put upon the board rather went to prove the justice of the idea of burning the gas at a rate which would give a constant illuminating power. It was the fixing of the rate of burning which had been making the difference; and if they increased the rate until they reached the 16-candle standard power, and then calculated back, a good deal of the trouble would be overcome. He was much obliged to the meeting for their recognition of the labours of the Committee. As its Secretary, he had witnessed most of the work done, and had helped with some of it; and he could assure his hearers that he had never seen a Committee who had more thoroughly put their heart into their work. They had held an enormous number of meetings; and, with one exception, there was scarcely ever an absentee. This spoke volumes for the ardour with which the Committee had entered into a most complex and difficult problem.

DISCUSSION ON MR. G. ERNEST STEVENSON'S PAPER ON "THE MODERN GAS-ENGINE: ITS DEVELOPMENT AND APPLICATIONS."

The PRESIDENT said Mr. Stevenson's paper had been written at the special request of the Council. It was felt that the relationship of the gas-engine to the development of the business of gas companies and gas corporations was so important that it would be highly desirable to include in the programme of this meeting a paper bringing their knowledge on the subject up to date. Mr. Stevenson had kindly consented to prepare one; and he (the President) was sure they would agree with him that it was a very creditable paper, and that the accompanying diagrams were most valuable. Mr. Stevenson had taken a great deal of trouble in preparing papers which he had not had the pleasure of reading or hearing discussed. His contributions to the Transactions of the Institution had been of the most valuable character; and, on the members' behalf, he thanked him most heartily for the pains he had taken in preparing them. There was one remark in the paper with reference to the gas-driving of exhausters. He was under the impression that this had been done; and if any gentleman could give them his experience, they would be pleased to have it.

Mr. J. STELFOX (Belfast) said he was one of those who had not a gas-engine on the works; and he did not think gas-engines for certain purposes were better than steam, as no one could question that there was a difficulty with regard to the regulation of speed for various requirements. He had seen them in several small works; and he knew of one instance where they were substituting steam for the gas-engine on the ground that, having the steam there for other purposes, it was more economical. He was under the impression that the first use of tube-igniters was claimed by Messrs. Andrews. He did not know whether or not this was true; but he believed they made that claim. He should also be glad if Mr. Stevenson could give the members some definite information with reference to the new engine of Messrs. Scott Bros., of Halifax, to which he had referred. He had made inquiries for some time, but could not learn anything definite about it.

Mr. C. GANDON (Lower Sydenham) said that he had for many years used gas-engines, and had found them very satisfactory for certain purposes. He should not advocate their use to supersede steam-engines for all purposes; but for intermittent work, they were most convenient. With regard to the use of gas-engines for driving exhausters, he could only refer to one place that occurred to him. That was at the gas-works at Smyrna, where they had been successfully employed for the purpose for many years. Why they were used in preference to steam-engines for that work he did not know, as he thought the great utility of a gas-engine was for intermittent use. At Sydenham, they had now seven or eight gas-engines in use.

Mr. T. HOLGATE (Halifax) wished to be permitted to answer the question put by Mr. Stelfox with reference to the gas-engine of Messrs. Scott Bros. He had had an opportunity of seeing one at work driving a dynamo; and it appeared to do that work very satisfactorily. He had made inquiries as to the gas consumption compared with the number of incandescent lights in use, and was surprised at the low consumption stated. He should not like it to be taken from that remark that the actual result was better than other first-rate gas-engines; but if the figures given were correct, the results were certainly very good. Where large gas-engines had been used, his experience had been that, instead of coke, anthracite coal had been employed for the generation of Dowson gas. In certain cases the users of the engines had paid 22s. a ton for the anthracite, as against 6s. 8d. per ton for gas coke. He should like to know the reason why so costly a material was preferred, because they all knew that Dowson gas could be made from coke. Near to the works with which he was associated, there was an extensive wire-working establishment, where they had put down several large gas-engines. Possibly they might have under-estimated the power required; but when a sudden demand was put upon the engines, they were found to be unequal to meet it. It might be that the cycle of operations in the gas-engines rather militated against their working satisfactorily for such a class of work; and this had been noticed as being a somewhat serious defect.*

* The gas-engines here referred to, Mr. Holgate since learns, are being supplanted by larger ones.

Mr. J. Tysoe (East Greenwich) said they had a gas-engine at their works of 12-horse power driving two exhausters. They were used in the winter time principally for pumping gas up to their other stations; and for this purpose, he found that the gas-engine was far preferable to the ordinary method of using steam, as it was available at very short notice. The capacity of the exhausters was about 400,000 cubic feet per hour. They had other gas-engines on the works, of a combined horse power of 94, used for the workshop and coal breaking and elevating machinery. He thought, on the whole, the result was very favourable; and for his own part he preferred them to steam-engines.

Mr. C. D. Drury (Sunderland) said they had about 350 gas-engines working in Sunderland, for many purposes. There was a 20-ton travelling-crane at the River Wear Commissioners' Docks worked by a 20-horse power nominal gas-engine. They obtained the motive power by means of a 3-inch flexible hose, which was coupled up to a 4-inch gas-pipe; and they had very good results. The price of gas in Sunderland varied from 1s. 11d. to 1s. 6d. per 1000 cubic feet, according to consumption; the average charge being 1s. 8d.

Mr. A. Edwards (Taunton) inquired whether the new type of engine had any, and if so what, advantages over the older type with regard to regulation? They had lost the service of several gas-engines because the number of revolutions per minute could not be absolutely controlled. He should like to know whether any means had been found to regulate—say, within about 1 or 2 per cent.—the number of revolutions per minute for the work to be done. With regard to tube-ignition, he was told by a gas-engine maker that this was invented and patented very early in the days of modern gas-engines, and that, as a matter of fact, the patent had run out some three years ago.

Mr. F. D. Marshall (Copenhagen) said, with reference to the question of driving exhausters by steam or gas engines, he had had some experience. They had made an experiment in a small works; and they found that, in the summer time, it was more advantageous to use the gas-engine to drive exhausters, as they could run day and night without much attendance, and there was absolutely no variation in the gauge. They had good governors on the engine itself. As regards their regularity, there was absolutely no variation day or night; and in this respect, they looked upon the gas-engine as a very valuable adjunct to the works. They made experiments again in the winter time by driving the exhausters with steam-engines, using breeze; and, taking into account the wear and tear on the boiler, and the wages of the men, they found the steam-engine and the gas-engine almost balanced each other. In the summer time, there was a considerable advantage in small works in using a gas-engine if it had a good regulator; and there was not the slightest difficulty with modern engines in accomplishing this. As far as tube ignition was concerned, the Otto patent had run out. Where possible, he thought electrical ignition was the most advantageous; being very serviceable, and very clean. It was a decided improvement, and a great step forward; and he did not think they would find gas-engines constructed with the old form of ignition.

Mr. Edwards asked to be allowed to add to his remarks that he had made inquiries of a manager who had charge of a small works where they drove the exhausters by a gas-engine, as to whether he was satisfied with the engine; and he replied that he should be very glad indeed to get rid of it. He had three exhausters installed; and notwithstanding this number was one more than a works of that kind should have, he was not able to so arrange that the exhauster would properly control the make of gas without bye-passing a considerable proportion of the gas back again. The exhausters were of three different sizes.

Mr. Gandon observed that this was a difficulty which could easily be overcome by using Fison's cone pulleys.

Mr. F. D. Marshall said it was possible that, in the course of the evening, they might have to put a weight or two on the bye-pass regulator. It was not necessary to have a trained man to look after the engine; it was only a question of having a good regulator. It must be regulated by the quantity of gas; and the bye-pass must be a very sensitive one.

Mr. Stevenson, in reply, thanked the President for the kind words which he had used with regard to the preparation of the paper. He was glad the discussion had called forth several remarks with respect to the driving of exhausters. He had seen exhausters driven by gas-engines; and in every case that he knew of, it had been necessary to bye-pass the gas to some extent, in order to maintain equilibrium, and to meet variations in the make of gas. In a small works, he did not think this was any disadvantage. If, for instance, a small works had an exhauster large enough to draw (by a gas-engine) all the gas made in the winter, and another suitable for the summer make, he thought that the thing could be worked very economically and easily by driving the exhauster slightly faster than the make of gas required, and using a bye-pass to return the surplus gas. He had suggested in the paper that an arrangement might be made by which the speed of the exhauster should be varied, while the gas-engine remained constant. There was Fison's appliance to which Mr. Gandon had referred; but he believed it was found to be rather a cumbersome thing. Some of them would be aware that there was a very ingenious regulating apparatus which had been tried at Deptford in connection with tramways, in which the driving was done through the contact of a roller on the face of a disc; the position of the roller or pulley on the disc being varied. The roller was moved between the centre and the periphery of the disc. As it departed from the centre towards the periphery, the speed increased, and *vice versâ*. He thought a modification of some such plan might be applied to driving gas-exhausters. If it could, it would certainly take up less space than any system of cone pulleys. With regard to tube-igniters, Messrs. Crossley Bros. said they introduced them—they had told him so in writing. He did not know whether Messrs. Andrews and Co. claimed to have introduced them or not. Scott Brothers' engines he had not seen himself; but they had sent him a diagram, judging from which the engine appeared to be of a very perfect character. Mr. Holgate had referred to a gas-engine in a certain installation not being equal to a sudden demand made upon it. In many establishments, gas-engines were not worked up to their full power. It was said that they could not, because they ran hot. The reason of this was simply because there was not enough water passing through the casings. If it were possible to spare the water, and throw away a certain quantity, instead of returning it to the circulating vessels, there would be no difficulty in working gas-engines at full power, and keeping them cool; but when all the water was constantly returned through the tanks, there was a difficulty. With regard to the new scavenging arrangement, its whole advantage was gained when the engine was running at full power. When the engine was working at half power, every alternate explosion missed. Then, of course, the scavenging would be done without this arrangement; because, if there was a miss, the next back-stroke would drive out everything, and on the next firing there must be a pure charge. The advantage of the scavenging arrangement was that, when working at full power, there was no deduction from the power of the engine due to the presence of waste gases. Whether they worked more or less regularly than the old type of engine, he could not say; but he could not see that it influenced that in any way. The engines he had worked with the utmost regularity; they gave no difficulty whatever. The moment the fly-wheel was turned on the first start, they gave no trouble to the end; and he did not think there could be any diminution of regularity in working. The regularity of gas-engines was certainly improving day by day. They were now being used so much for electric lighting that it was absolutely necessary they should be perfectly uniform in speed. He knew of some gas-engines that had been used for driving dynamos which had been complete failures; but, on the other hand, some of the best makers could satisfy all demands. With regard to the fuel used for Dowson gas, he believed it was true that the gas was not so well made with coke as with anthracite. It became thin; and there was a difficulty in producing it of sufficient strength. If the gas was of a thin diluted quality, then the charges did not ignite promptly. There was what was called "late ignition," which often resulted in irregular working of the engine—an uneasy working which shook and damaged the engine. He was not able to say very much in reply in the discussion, as it was a subject in which one had not very much personal experience. The information he had been able to give to the meeting had been principally gained from the makers, with some personal observations.

DISCUSSION ON MR. LEWIS T. WRIGHT'S PAPER ON "THE TEMPERATURES EMPLOYED IN THE DISTILLATION OF COAL."

The PRESIDENT, in thanking Mr. Wright for his most able paper, said he was sure all the members would give him a hearty welcome on this, his first appearance at a meeting of gas managers after his long absence from this country. He (the President) knew of no one who had given so much time and attention to getting at the bottom of what took place during the carbonizing of coal in ordinary retorts. The present process was by no means perfect. Anyone who had much to do with it would admit that it was only by the persistent making of experiments, under every possible condition, that they could arrive first of all at what was theoretically right, and thereby at a basis on which to work in practice. He would ask Mr. Foulis, who knew a great deal about that matter, to open the discussion.

Mr. W. FOULIS (Glasgow) said he was somewhat at a disadvantage, as he had not read the paper, and had only heard a portion of it; but it always seemed to him that the state of retort temperature was exceedingly difficult to arrive at. He had always thought that the temperature outside a retort was a much better indication of the temperature available for carbonization than that inside. Unless there was a high temperature outside, it was impossible to convey the heat with sufficient rapidity to the coal to carbonize it properly.

Mr. T. S. LACEY (Pimlico) said everyone knew that the temperatures of the outside and inside of a retort bore no definite relation to one another; and, of course, it partly depended on the amount of coal inside. It was quite possible to imagine that, by working at a low temperature with a very thin layer of coal, one might get a large make per ton; while by having a very thick layer and a high temperature, one might get a bad make per ton, together with bad results in other ways. What was the best form of retort and the best thickness of coal had not yet been definitely decided. Some had a preference for one form, and some for another; and it could not be taken for granted that any particular shape of retort was very much better than others. Having had the opportunity of comparing the results of various works, he was inclined to think that the best form was by no means settled at present. Very good results were obtained with round, oval, and Ω-shaped retorts, and by those which had a large space over the surface of the coal, which some thought a very dangerous practice. He had seen good results when the retort was nearly full. But he thought the importance some attached to having the retort as nearly full as possible, was a matter on which sufficient evidence had not yet been adduced; and as this was an opinion held by a great many engineers, it would be interesting to know whether other members had any experience as to the effect of the depth of the charge, and the space above it, on the results obtained.

Mr. J. W. HELPS (Croydon) said it was exceedingly difficult to discuss such a paper as the one before them without having had plenty of time to consider it. No doubt, as Mr. Wright said in the early part of his communication, the results of experimental and practical work varied to a great extent. With regard to the temperature at which coal was generally carbonized, he (Mr. Helps) quite agreed that very little had been known or worked out; and he thought few really appreciated the fact which had been brought forward that day, that there was a constant and considerable difference of temperature between the outside of the retort, or the flue, and the varying temperature of the coal inside.

Mr. S. GLOVER (St. Helens) said he felt very much indebted to the author for bringing forward the subject of temperatures. The question of carbonizing coal was no very easy matter. They all knew that the same treatment would not do for varying qualities, and that the heat outside a retort was greater and more constant than that inside, which had to deal with a charge of cold coal. Quite recently he was looking into this subject with regard to the best temperature for carbonizing coal of a small and poor quality; and he held that the method of placing the coal in the retort was an important feature to be borne in mind. Mr. Wright would probably allow that, to get constant results from experiments, the coal ought in each case to be carefully placed in the retort, so that it should always be dealt with under the same conditions in each experiment. In his case, working with West's hand machine, they always had a very level charge; and he believed he owed to this fact some of the good results they obtained in carbonizing poor coals. He had lately, in considering the Peebles process of manufacturing oil gas, come to the conclusion that some of the advantages of the process were dependent on having a large retort for the quantity of gas being made; so that the gas treated inside the retort was not brought so much under the influence of contact heat as of radiant heat. These two features were very important. He believed in having a considerable extent of empty space above the coal in the retort; and, in his opinion, equally good results could not be obtained by bringing the material near the top. He thought a great deal of the chemical decomposition referred to in the paper was brought about by contact heat. He did not know if it was the author's experience that all retorts varied in temperature. Probably he might have seen some which were very nearly regularly heated from the centre towards the mouthpiece. This was a very important point to aim at, so that the coal should be carbonized at an equal temperature throughout the length of the retort; the coolest part being, of course, just approaching the mouthpiece. It was difficult to discuss a paper like the one before them without careful consideration; but there was a great deal of food for thought in it.

Mr. WRIGHT, in reply, said the gist of his paper was this—that, if they raised the exterior temperature of the retort, they increased the quantity of heat going in, and the rate of gasification. But he found in his experiments that, by raising the exterior temperature (and consequently the rate of gasification) beyond the limits commonly employed in practice, the production of gas per ton of coal was not necessarily augmented. If they worked at what were called higher heats, or higher exterior temperatures, in an ordinary way, the more rapid the rate of gasification, up to a certain point, the more did the volume of gas produced from a ton of coal increase. In these experiments upon results up to very high temperatures, the rates of gasification being much higher than were commonly employed, it was found that the increase in the volume of gas was not extended into that higher range of temperature. On the contrary, in some cases, at the highest rate of gasification, the yield of gas was rather less than at a medium temperature. The matter that seemed most to have occupied the attention of the meeting was what would probably be the best form of retort; but to this he had purposely not alluded, because it formed part of other experiments he had been engaged upon, which he hoped some day to bring before them. The observation he had now made—that, after a certain rate of gasification was reached, the increase in the yield of gas per ton no longer went on, but that, on the contrary, there was a tendency in some cases for the volume to be reduced—had, he believed, never been made before. He would, therefore, have liked to have had the views of the members upon it; because a perfectly new observation of this kind was one which should excite some criticism. He did not ask them to believe it until they had tested it; but he would have been pleased if they had been able to produce even some facts, if possible, to show that it was not always so. He must leave it for them to judge as to whether or not it was correct. As to increased rate of gasification, there was no danger, after a certain point, of breaking down the quality of the gas.

Mr. FOULIS asked if he understood Mr. Wright to say that, above a certain temperature, the make of gas per ton diminished with the temperature. If so, what was the temperature referred to?

Mr. WRIGHT said that was the result of his experiments. The temperature would be found in the tables.

Mr. FOULIS said he was working at heats above those likely to be obtained in any test apparatus; and he never found such a result. He was making 9000 cubic feet per mouthpiece with comparatively small retorts. He did not think one could gasify faster than that. He did not say the author's statement was not true; but it was rather a startling one.

Mr. WRIGHT said the only test was the quantity of coal carbonized in a given time. The experiments showed the rate of gasification of 15 tons per 1000 feet of retort surface. If in Mr. Foulis's works they reached this figure, he would have an opportunity of knowing whether the results he had obtained were normal or abnormal. He (Mr. Wright) had always observed, in experiments where the "heats" had

been pushed—employing rates of gasification which were not possible in practice with the forms of apparatus generally used, because in two days the ascension-pipes would be stopped up, and the hydraulic main would give trouble—that the tendency of the volume of gas per ton of coal to increase disappeared, and in some cases actually diminished. He employed in his experiments a set of retorts similar to those used in gas-works actually in practice. The only difference was the extra care taken in making the observation

ACETYLENE AND ITS ENRICHMENT VALUE.

By Vivian B. Lewes, F.I.C., F.C.S.

The commercial manufacture of calcic carbide by means of the temperature available in the electric furnace, has made the preparation of acetylene on a large scale a practicable possibility; and it is of manifest importance that gas engineers should know to what extent this new illuminant may be capable of aiding them in obtaining those higher illuminating values which fashion and the wisdom of Parliamentary Committees decree to be a necessity in certain places.

At the present time, the question of the cheap production of aluminium is one which is occupying an enormous amount of attention; and several processes have been devised in which the electric furnace plays an important part. A Mr. T. L. Willson had devised such a process; but, being restrained by an injunction obtained by a company holding patents of a similar description, he found himself debarred from carrying on work upon aluminium. While attempting to utilize his electric furnace for obtaining the metal calcium by reducing lime with finely-powdered charcoal, he found that at the temperature of the electric arc an inter-action took place, which resulted in the evolution of carbon monoxide, and left behind a fused mass which solidified to an extremely hard semi-crystalline body. Finding this was not the substance he had hoped to produce, it was thrown into the stream which gave the water power for working the dynamo; and the instant evolution of large quantities of gas attracted attention. More of the same material was then made and examined chemically, when it was found to be a body known as calcic carbide, which contains 40 parts by weight of calcium combined with 24 parts by weight of carbon, and which, upon being treated with water, gives a copious evolution of the hydrocarbon gas acetylene. On the addition of water to the calcic carbide, a double decomposition takes place; the oxygen of the water combining with the calcium, and once again forming lime, while the hydrogen unites with the carbon of the carbide to form acetylene—a gaseous compound in which 24 parts by weight of carbon are united to 2 parts of hydrogen.

The compounds called carbides had been known for a considerable period. As early as 1836, it was found that, when making potassium by distillation from an intimate mixture of potassic carbonate and carbon, a small quantity of a bye-product consisting of a compound of potassium and carbon was produced, and that this was decomposed by water with liberation of acetylene; while Wohler, by fusing an alloy of zinc and calcium with carbon, made calcic carbide, and used it as a source from which to obtain this gas by the action of water.

Nothing more was done until 1892, when Maquenne prepared barium carbide by heating at a high temperature a mixture of barium carbonate, powdered magnesium, and charcoal—the resulting mass evolving acetylene when treated with water; while, still later, Travers made calcic carbide by heating together calcic chloride, carbon, and sodium.

The calcic carbide, as produced by Willson, appearing to give promise of providing a source from which acetylene could be made on a commercial scale, experiments were instituted in America; and from there we have received details, of an extremely variable and uncertain character, as to the cost.

Calcic carbide is a dark grey substance having a specific gravity of 2·262; and, when pure, 1 lb. of it will yield, on decomposition, 5·3 cubic feet of acetylene. Unless, however, it is quite fresh, or means have been taken to carefully protect it from air, the outer surface becomes slightly acted upon by atmospheric moisture; so that in practice the yield would not exceed 5 cubic feet. The density and hardness of the mass, however, protect it to a great extent from atmospheric action; so that in lumps it does not deteriorate so fast as would be expected. But in the powdered condition it is quickly decomposed.

The acetylene prepared from calcic carbide by simply allowing water to drip upon it in a properly constructed generating vessel, when analyzed by absorption with bromine (the analysis being also checked by precipitation of silver acetylide), gives 98 per cent. of acetylene, with 2 per cent. of air, and traces of sulphuretted hydrogen—the presence of this impurity being due to traces of sulphate of lime (gypsum) in the chalk used for making it, and to pyrites in the coal employed.

Acetylene is a clear, colourless gas with an intensely penetrating odour, which somewhat resembles garlic. Its strong smell is a very great safeguard in its use; as so pungent is this odour that it would be practically impossible for a leak, however small, to remain undetected. This is an important point to remember, as the researches of Bistrow and Liebreich show that the gas is poisonous, though not so deadly as carbon monoxide—both acting by combining with the hæmoglobin of the blood. The great danger of the latter gas, however, is that, having no smell, its presence is not detected until symptoms of poisoning begin to show themselves.

Acetylene is soluble in water and most other liquids, and, at ordinary temperature and pressure (60° Fahr. and 30 inches of mercury), 10 volumes of water will absorb 11 volumes of the gas; but as soon as the gas is dissolved, the water, being saturated, takes up no more. Water already saturated with coal gas does not take up acetylene quite so readily; while the gas is practically insoluble in saturated brine—100 volumes of a saturated salt solution only dissolving 5 volumes of the gas. The gas is far more soluble in alcohol, which, at normal temperature and pressure, takes up six times its own volume of the acetylene; while 10 volumes of paraffin under the same conditions will absorb 26 volumes of the gas. It is a heavy gas, having a specific gravity of ·91.

When a light is applied to acetylene, it burns with a luminous and intensely smoky flame; and when a mixture of 1 volume of acetylene with 1 volume of air is ignited in a cylinder, a dull red flame runs down the cylinder, leaving behind a mass of soot, and throwing out a dense black smoke. When acetylene is mixed with 1·25 times its own volume of air, the mixture begins to be slightly explosive. The explosive violence increases until it reaches a maximum with about 12 times its volume of air; after which it gradually decreases in violence until, with a mixture of 1 volume of acetylene to 20 of air, it ceases to be explosive.

The gas can be condensed to a liquid at a pressure of 21·5 atmospheres at a temperature of 0° C. The liquid so produced is mobile and highly refractive; and, when sprayed into air, the conversion of the liquid into the gaseous condition absorbs so much heat that some of the escaping liquid is converted into a snow-like solid, which catches fire on applying a light to it, and burns until all the solid is converted into gas and is consumed.

In papers read before the Chemical Society in 1893, and the Royal Society in 1894-5,* the author has shown that, when coal gas or other hydrocarbon gas leaves the jet at which it is being burnt, those portions which come in contact with the air are consumed, and form a wall of flame which surrounds the issuing gas. The unburnt gas, in its passage through the lower heated area of the flame, undergoes a number of chemical changes brought about by the action of radiant heat emitted by the flame walls, the principal of which is the conversion of the hydrocarbons into acetylene, methane, and hydrogen. The temperature of the flame quickly rises as the distance from the jet increases; and a portion of the flame is soon reached where the heat is sufficiently intense to decompose the acetylene with a rapidity almost akin to detonation. The heat of its formation, thus liberated and localized by the rapidity of its decomposition, raises the nascent carbon particles to incandescence, thereby giving the principal part of the luminosity to the flame; while these particles, heated by the combustion of the flame-gases, still continue to glow until finally themselves consumed—this external heating and final combustion adding slightly to the light emitted.

Acetylene being the main factor in producing luminosity,

* See *ante*, p. 796.

it was to be expected that, when burnt alone, it would yield an exceptionally high illuminating power; and this was found to be the case.

A considerable amount of vagueness exists as to what is meant by the illuminating value of a gas; and the only assumption which can be arrived at is that it is the highest illuminating effect which can be produced from the gas without the aid of regeneration or artificial air supply other than that created by the flame itself. The proper combustion of any hydrocarbon gas, however rich, can be effected by supplying the flame with exactly the amount of air necessary to prevent smoking; and it is under these conditions that the highest illuminating effect possible with the particular burner is obtained.

With flat flames, the ratio between the air supplied and the gas consumed is governed by two factors: (*a*) The thickness of the flame; (*b*) the pressure under which the gas issues from the burner. When a gas issues from a burner under pressure, the uprush of the escaping gas mechanically draws in air; so that when consuming a poor coal gas in a flat flame, the pressure has to be kept down, or too much air would be dragged in, which would consume the hydrocarbons too rapidly, and so seriously affect the amount of light emitted. As the gas increases in illuminating value, more and more air is required for proper combustion; and this can be obtained by increasing the pressure at the burner.

Experience has shown that with ordinary-sized flat-flame burners, 7-10ths of an inch in pressure gives practically the best result with coal gas of the quality supplied in London; and up to a certain limit the same flat-flame burner can be used for richer gases by increasing the pressure. When this limit is reached, a thinner sheet of flame has to be employed—*i.e.*, a smaller burner used—low initial pressure resorted to, and then by increase of pressure this can be made to consume gases of increasing value, until the pressure reaches a point at which the flame becomes distorted, when a still smaller burner has to be taken. By such means as these, even acetylene, with its enormously high illuminating value, can be satisfactorily consumed; while by thickening the flame, and reducing the pressure to the point at which the uprush almost ceases to cause a mingling of air with the flame, and leaves the supplying of the oxygen to diffusion, even a poor gas can be made to develop its illuminating power.

On consuming acetylene from a No. 000 union-jet burner, at all ordinary pressures, a smoky flame is obtained; but on increasing the pressure to 4 inches, a magnificent flame results, free from smoke, and developing an illuminating value of 240 candles per 5 cubic feet of gas consumed. Slightly higher values have been obtained; but 240 may be taken as the average value under these conditions.

Most of these points were determined last December, and are to be found in a paper read before the Society of Arts last January [see *ante*, p. 168]. The enrichment value of the gas, however, required a long series of somewhat laborious experiments in order to ensure the results being of value; and, as nothing was known as to its powers of enriching, expectations as to its value could only be based on the supposition that they would at any rate be proportional to the results obtained when burnt alone, even if it did not give higher enrichment figures, as in the case of Mr. Young's oil gas.

In order to ascertain the enrichment value of the acetylene, coal gas which had been stored in a holder for some time, and which had an illuminating value of 13 candles per 5 cubic feet, was employed. This gas, from long standing, might be considered to have deposited all condensable vapours, and was used in order to prevent any question of vapour tension interfering with the results.

In determining the illuminating value of mixtures of coal gas and enrichers, too little attention is, as a rule, paid to several important points. Chief among these are, first, that the mixtures shall be as nearly perfect as possible, and free from stratification; and, secondly, that the exact percentage of the enriching gas supposed to be present is really there—this latter being especially important when gases even slightly soluble in water are being used.

In the following experiments, the method employed was to use a 5 cubic feet holder, the water of which was fairly saturated with hydrocarbons, and to run into this the 13-candle coal gas and the acetylene, already roughly mixed, by passing them *pro ratâ* into a wash-bottle, from which they travelled on together into the holder; thus making a mixture which was to contain 10 per cent. of acetylene with 90 per cent. of coal gas. The flow of gas and acetylene into the wash-bottle was so arranged that 4·5 cubic feet of coal gas were passed through the bottle, entering it by one tube, while 0·5 cubic foot of acetylene passed in through a second tube.

The mixture, when made, was allowed to stand overnight, in order to allow diffusion to perfect the mixture; and a long series of experiments show that this effectually prevented any stratification of the gases. The acetylene, however, being slightly soluble in water, the lower portion of the mixture in contact with the water might occasionally contain a trace less acetylene than the portion near the top of the holder. To provide against any inequality in the mixture, and also to give a check analysis, the gas was analyzed as it left the burner at the commencement of the experiments; while a second analysis was taken also from the burner at the conclusion of them—the mean of these two experiments giving the composition of the mixture dealt with.

In taking the illuminating power, Mr. Dibdin's 10-candle pentane Argand was used as the standard; and the mixture was burnt in the "London" Argand burner with a 3-inch flame. The rate of flow having been noted, the illuminating effect was calculated to a consumption of 5 cubic feet. The illuminating value was also determined in a set of Bray's "Special" union-jet burners; the richer mixtures being burnt in the sized burner which gave a slightly smoky flame at ordinary pressures—the pressure being then increased until the flame ceased to smoke. The pressure at which the test was made was duly noted.

With illuminating values up to 20 candles, the "London" Argand gave the best results. But above that, as might be expected, the flat-flame burners developed the largest illuminating power—indeed, a limit was soon reached at which it was impossible to use a 3-inch flame in the Argand. In every case, the highest illuminating value recorded—each being a mean of ten readings—was taken as the illuminating power of the mixture.

An example of one test will suffice to make this method of determination clear; and although the method is laborious, it is the only one which can be relied upon to yield results of any value.

Analysis of the Mixture.

	Commencement of Test.	End of Test.	Mean.
Acetylene	17·0	16·5	16·75
Coal gas	83·0	83·5	83·25
	100·0	100·0	100·00

Tests for Illuminating Power.

Burner Used.	Illuminating Power per 5 Cubic Feet. Candles.	Pressure. Inch.
"London" Argand	26·2	3-10ths
No. 9 Bray flat-flame	smokes	8-10ths
9 "	32·7	12-10ths *
8 "	32·8	12-10ths *
7 "	34·3	12-10ths *
6 "	36·1	12-10ths
5 "	34·5	12-10ths
4 "	34·5	12-10ths
4 "	34·7	9-10ths
4 "	34·3	6-10ths
3 "	34·1	12-10ths
2 "	32·3	12-10ths

* Show a tendency to smoke.

Therefore a No. 6 Bray, with a pressure of 12-10ths of an inch, gives the value of mixture as 36·1; and—

$$\frac{36{\cdot}1 - 13}{16{\cdot}75} = 1{\cdot}36 \text{ enrichment value.}$$

Working in this way, the following values were obtained:—

Percentage Composition of Mixture.		Illuminating Value.		Enrichment Value of 1 per Cent. in Candles.
Coal Gas.	Acetylene.	Coal Gas.	Mixture.	
99·10	0·90	13	13·9	1·00
97·90	2·10	13	15·1	1·00
96·00	4·00	13	17·3	1·07
95·20	4·80	13	18·4	1·12
91·00	9·00	13	23·5	1·16
89·50	10·50	13	25·3	1·17
85·00	15·00	13	33·0	1·33
83·25	16·75	13	36·1	1·36
66·90	33·10	13	60·5	1·43
55·50	44·50	13	76·7	1·43
16·70	83·30	13	175·2	1·94
00·00	100·00	..	240·0	2·40

This shows that, for small enrichments of illuminating power, acetylene has an enriching value but little better than Young's oil gas, which Mr. Glover has found in practical working to give an enrichment of 0·96 for each per cent. added. As the additions of acetylene become larger, the enrichment value gradually rises; but on plotting out the results of the experiments in a curve, the enrichment value is always found to be less than the photometric value of the gas when burnt *per se*.

These results show that acetylene will be of no practical use to the gas manufacturer for the enrichment of gas in bulk, as it can never hope to compete in price with oil gas as made by the Peebles process. They further show that the great value of the gas as an illuminant is only developed when burnt alone. There are many cases, however, in which enrichment in bulk is not continuously required, but where the gas manager would be glad of a simple and inexpensive form of apparatus which could instantaneously be started in the event of his gas unexpectedly falling below the standard.

The curious anomaly which makes an oil gas, with a photometric value of only 60 candles, develop an enrichment value of 96 candles, while a pure hydrocarbon like acetylene gives an enrichment far below that which one would expect from its photometric value, suggests many most interesting points. In a paper now being prepared, the full explanation of this phenomenon is worked out, and it supports in a remarkable way the truth of the explanation of the luminosity of hydrocarbon flames being due to the thermal changes taking place during the rapid decomposition of certain compounds.

Discussion.

The PRESIDENT said they were deeply indebted to Professor Lewes for his very interesting paper, and the experiments he had conducted, showing the intense luminosity of the acetylene flame, which was very impressive, even in the well-lighted room in which they were assembled.

Mr. LEWIS T. WRIGHT (London) said Professor Lewes had reminded them how, a little time ago, there was some doubt thrown on the enrichment value of acetylene. It fell to his (Mr. Wright's) lot, at the time when Professor Lewes favoured them with the first introduction of this light, to observe that possibly the high illuminating value of acetylene, when burned in a pure state, would not be preserved when it was mixed in small percentages with coal gas; and those who had carefully watched the various discussions and articles which had followed, would remember that Professor Lewes immediately, with great frankness, promised to make an investigation, and to present the results, for better or worse, to the gas industry. That promise he had fulfilled, not only to the letter, but to the spirit; and they must all be very much obliged to him for the very candid manner in which he had given the results. There were many matters he (Mr. Wright) would have liked to discuss with reference to the remarks in the paper, which had interested him very greatly; but they would occupy far too much time to attempt to deal with them then. The various theories Professor Lewes held with respect to illuminating flames were not such as he (Mr. Wright) could endorse in every particular; but it occurred to him that it might be as well, now that acetylene had got down to its bearings, and now that they knew what its value might be within the limits in which it could be of service to the gas industry—namely, for enriching coal gas by 1 or 2 candles (for that was really the interest it had to the gas industry)—to go a little farther, and ascertain what acetylene might do with gas of 100 or 200 candle power. Of course, gas managers were most interested in qualities of 16 to 17 candles. The figures which had been given them would, he believed, stand the test of time, because they appeared to have been arrived at with very great care; and he should like to make a comparison between them and what could be obtained from benzol. With regard to illuminating power, it was always necessary to take account of carbon density. They might have a vapour, such as acetylene vapour, which contained 2 atoms of carbon in a molecule; or a hydrocarbon, such as benzol, which contained 6 atoms of carbon. So that, in the same gaseous volume, they might have in different hydrocarbons different carbon densities. It was necessary therefore, in regarding the enrichment values of these hydrocarbons, not to lose sight of the carbon density, because the lighting value depended very largely upon the carbon; and as these hydrocarbons differed very much in this respect, any comparison between them must be conducted on this basis. Reducing the acetylene, as given in the tables in the paper, to a carbon density of 1, he found that it would give (say) 10 candles. On the same basis reducing benzol vapour to a carbon density of 1, in his own experiments he had been able to obtain 7 candles—that was to say, in small percentages under 1 per cent., acetylene would give 10 candles, while benzol would give 7 candles for the same amount of carbon put into the flame. Some observers made benzol yield more than 7 candles; but he would rather make use of the figures that were the result of his own experiments, because he could speak of them with more confidence. Carrying the comparison between acetylene and benzol into a higher grade of gas—acetylene in the proportion of 17 per cent. of gas in the mixture—it would be seen that the percentage was 1·36, or as he had expressed it in a recent paper before the Society of Chemical Industry, on the carbon efficiency of coal-gas flames,* 13·6 candles per cubic foot of carbon vapour, as against 10 candles at about 2 per cent. of acetylene; while acetylene at low percentages gave 10 candles according to these tables, and benzol gave 7 candles. At a higher grade acetylene gave 13·6 candles, and benzol would give 12·5 candles. So that benzol vapour, taken on the basis of the carbon it contained, was of practically the same value as acetylene. This went to prove that the carbon of these hydrocarbons, whatever might be their nature, and whatever they might do when burnt under satisfactory conditions *per se*, when mixed with a variety of other gases, down to a grade of 16 or 17 candle gas, tended to assume a value of about 7 to 10 candles per cubic foot of carbon vapour. As far as he could see, these results supported the contention he brought before the Society of Chemical Industry. The question of cost was not of very great interest, now that it was admitted that acetylene had no particular value for the gas industry as a source of enrichment. But Professor Lewes knew very well, as an accomplished chemist, that it was possible to make a calculation based upon thermo-chemical data respecting the amount of energy required to produce a ton of calcic carbide. They knew how much heat was needed to raise the various products entering into the reaction to the temperature necessary for that reaction, as well as certain other thermo-chemical data; and if he would make the calculation, he would find that it would require considerably more than 5000-horse power to make a ton of pure calcium carbide, which was a very large amount of energy. Many scientific people had been attracted by this subject of the synthesis of acetylene. They said possibly this might have been the means by which the deposit of natural petroleum in the bowels of the earth had been produced; and again the same synthesis might be made use of to produce, if not coal, at least materials which were almost identical with it. This would seem a very interesting problem to work out, because it appeared that the knowledge now possessed was an arm by which, if coal were exhausted, it would be possible to make it with the aid of water power. But it must be remembered that the advantage of water power looked very much greater than it really was, because if one examined the figures of an Electric Light Company—the Westminster Electric Light Company, for instance—it would be found, taking the proportion of cost due to coal, that, even if the Company had their coal given to them, it would still cost a considerable amount to produce the electric energy. The total per unit was 2·69d.; and of this, 0·65d. was for coal. So that, if the cost of the coal were deducted, and the Company had their coal for nothing, the cost would still be 2d. If they could get water power for nothing, it would probably still be expensive to make coal, or materials of a similar character, in an electrical furnace, even with water power at no cost at all. Professor Lewes had remarked that the smell of this gas was not that which has commonly thought to be the smell of acetylene; and it occurred to him that probably, as this calcium carbide was manufactured from coal and lime, the coal contained a certain amount of phosphorus, and it might be that in the manufacture a certain amount of calcium phosphide was also formed. He should liked to know, therefore, if any experiments had been made to ascertain whether the carbide contained phosphide, because in that case the smell would be amply accounted for.

* See *ante*, p. 310.

Mr. W. Foulis (Glasgow) said he had read with very considerable interest all that Professor Lewes had written on the subject before them, and had witnessed the experiments with much admiration. Professor Lewes had just stated that he was preparing an additional paper on the matter, which no doubt would be of much value. In the meantime, however, he should be pleased if Professor Lewes could, without any breach of faith, give some indication of what theory he had formed as to why acetylene did not raise the illuminating power of gas, when put into it directly as acetylene, to the same extent that it did when it was formed in the flame by the action of heat or other hydrocarbon compounds. He thought this would add very much to their appreciation of the subject.

Mr. J. Methven (Beckton) said the reading of the paper brought to his recollection an experience he had recently had in the enrichment value of carburetted water gas, which he did not think had been recorded before. They knew that there was a considerable difference between the nominal candle power of oil gas manufactured by the Young process, and its so-called enrichment value; and this fact led him to make some experiments on the enrichment value of carburetted water gas. Hitherto they had taken the quality of this gas as that indicated by the photometer (using the most suitable burner for the purpose), just before its admission into the gasholder, where it was mixed with ordinary coal gas. Testing at regular intervals throughout the 24 hours, and taking also the value of the coal gas obtained in the same manner before admixture with the carburetted water gas, they found from the quality of the mixture, that the calculated value of the carburetted water gas as an enricher gave them almost the same proportional addition to its value as was claimed for the Peebles process for its enrichment value over and above its nominal value. It did not seem that they had yet arrived at the real cause of this addition to the nominal quality of the gas. It was interesting to notice that, in the case of carburetted water gas, possessing a quality of from 20 to 25 candles, they found the same considerable difference existing between the nominal and enriching value. He had not the exact figures with him; but they might take it that they found an addition of more than 20 per cent. to its nominal value when they spoke of its enrichment value to coal gas. With regard to Mr. Wright's remarks on benzol, he might say that they had been using benzol as an enricher in the same way as they used petroleum or light spirit for carburetting coal gas, and found very satisfactory results.

Professor Lewes asked Mr. Methven if he had any idea what the enrichment value from benzol was.

Mr. Methven said he had not any figures; but it might be taken that 1 gallon of benzol would go as far as 2 gallons of rectified petroleum.

Mr. T. B. Ball (Rochdale) said he had been using benzol as an enricher, and found it had a slightly higher value, as compared with carburine, than Mr. Methven had stated. But that gentleman had not stated what kind of benzol he used—whether it was the ordinary 50/90 or 90 per cent. benzol; and this might have some influence upon the value he had obtained from it. He understood Professor Lewes to say that all the hydrocarbons were converted into acetylene in the non-luminous zone of the flame before they reached the light-giving portion. If this was so, the benzol would also be converted into acetylene in the same way; and as this could now be obtained at an almost nominal figure, of course it gave it great advantage over acetylene, and, at the present time, almost every other competitor. The price of light petroleum spirit was very high now, in comparison with what it was twelve months ago; and this had prevented their continuing its use. But the application of the benzol in its place seemed to promise very satisfactory results; and certainly, as compared with petroleum spirit, it was more than twice the value. So far as he knew, no one had yet determined the actual worth of benzol vapour when burnt by itself; and one could not say whether there would be any difference between the illuminating value so determined and its enrichment value when added to coal gas in the same way as acetylene—that was to say, whether the enrichment curve was above or below the calculated value.

Mr. Methven said his impression was that they used the best quality of benzol—90 per cent.

Mr. C. E. Botley (Hastings) remarked that an apparent gain of illuminating power was noticed in the early days of carburetted water gas. Experiments were carried out to see if the same effect occurred in coal gas; and it was found that there was an increase in the illuminating power. In taking two different qualities of gas and mixing them together, there was more than the average of the two, though not so great an increase as in the case of carburetted water gas and coal gas mixed. He wished for information as to the effect of compression on acetylene.

Mr. S. Glover (St. Helens) said he had followed the paper with great interest; and he still believed that the enriching value of acetylene had not been heard the last of. It was quite possible that, in the future researches which would be made, it would be found that some different arrangement of burner might be provided for the consumption of coal gas enriched with acetylene, which would not cause it to split up—if it was a splitting up which went on in the flame—but would develop to the full its light-giving value. With regard to the facility with which acetylene might be used as a stand-by for occasionally enriching gas, he might say that by the oil-gas process one could bring this about in as short a time as it could possibly be done by having a plant lying by containing acetylene. He was much interested in hearing that the manufacturers of carburetted water gas were beginning to find out how to reckon the true enriching value of their gas. It was pointed out now that the enriching value was 20 per cent. more than its own illuminating power; but this still showed a considerable difference between the enriching value of oil used in that way, and oil employed in the best possible manner. The enriching value of Peebles oil gas was 50 per cent. higher than the illuminating power when burnt alone; and the fact that the enriching value of water gas was only 20 per cent. more than the illuminating power, tended to show that, the best value had not been got out of the oil used in the manufacture of carburetted water gas. A considerable quantity of the oil was required to bring up the water gas to any illuminating power at all. Still it was interesting to find that the ultimate enriching value of the carburetted water gas was 20 per cent. more than its illuminating value.

Professor Lewes, in reply, said he must admit that he had listened to the discussion with more than usual interest. Starting first of all with Mr. Lewis Wright's remarks, there was not the slightest doubt that, as regarded enrichment values, they must, of necessity, depend to a certain extent on carbon density; but it must also be remembered that the carbon density had to be looked at in a particular way, which he would explain in a few minutes. As to the question of phosphoretted hydrogen in acetylene, there was no doubt in some kinds of coal phosphorous was present, but in excessively minute percentages; and in acetylene obtained from calcium carbide, it was only natural to search for the presence of phosphorous when one noticed the smell of the gas. No trace, however, had been detected. The acetylene made in this way would contain (when produced with even common care) 98 per cent. of acetylene, $1\frac{3}{4}$ per cent. of air, and the remaining $\frac{1}{4}$ per cent. of sulphuretted hydrogen, which was due probably to traces of gypsum in the lime and sulphur in the coal. It was manifestly some other compounds, due to imperfect combustion, which gave the smell generally associated with acetylene. With regard to thermo-chemical energy, he was sorry to say that, though he was looked upon as a scientific man, he had considerable doubt as to the utility of thermo-chemical calculations, as carried out by many gentlemen; and he much preferred data obtained from practice. Now in regard to Mr. Foulis's question: Why was it, if one had acetylene burning with a candle power of 240, it only gave a mean enrichment value of 1·36; and why should oil gas, with a photometric value of 60, give an enrichment value of 0·96? A large percentage of the luminosity of hydrocarbon flames was due to the endothermicity of the acetylene. This compound had, during its formation, taken in a large amount of heat, so that, when the moment came for the decomposition of the acetylene, instead of having to garner in heat from all around, in order to carry on its decomposition, it was able to decompose, almost with explosive rapidity, into carbon and hydrogen. The heat which was stored up in it being localized, raised the carbon particles to the intense degree of incandescence which gave light to the flames. It was only to a small extent that the external conditions and the flame-gases gave that heat; and the maximum amount of the illumination—say, 80 or 90 per cent., came from the instantaneous

decomposition of acetylene in the flame. Experimentally, one could prove that the hydrocarbons all became acetylene before luminosity commenced. Experimentally, one could prove that, taking acetylene, and heating it up in a tube where no air could get to it, and where there could be no true combustion, the splitting up of the acetylene gave light. Beyond that, experiment at the moment could not go. There were the two factors; and taking these together, the luminosity of the flame was explained. Assuming, then, that luminosity was due to the liberation of heat by decomposition of acetylene with enormous rapidity, one immediately had the explanation for which Mr. Foulis asked. Perhaps only 5 or 6 per cent. of the acetylene as it issued from the burner had to be consumed without decomposition of the molecules, in order to give the necessary heat. The endothermicity in that body, when burning in this way, was made available for heating purposes. Therefore the small percentage burning gave intense heat, and decomposition of the remainder took place; and the result was intense luminosity. They had practically the maximum luminosity one could get from this amount of carbon. In enrichment, the acetylene was mixed with coal gas. By doing this, they widely separated the molecules of acetylene from each other; and, as he had shown clearly and conclusively, for every 10 per cent. that they diluted the acetylene, they required 100° higher temperature to reach the point at which acetylene decomposed. Therefore, the greater the dilution of the acetylene—in other words, the smaller the proportion mixed in as an enricher—the greater the amount of heating work would the remainder of the gas have to do in order to reach the point at which luminosity was developed. This fully explained the enrichment values. If they employed acetylene as an enricher, they obtained a mean value of 1·36. The photometric value of acetylene was 240; and therefore the enrichment value was not much more than half what one might expect. Butylene, on the other hand, had a photometric value of 123; but its enrichment value was 1·36 to 1·40. The enrichment value of butylene was practically the same as that of acetylene. This meant that, when butylene was breaking up, they had in that compound four atoms of carbon, and six of hydrogen, which gave two molecules of acetylene. But the heat which was evolved by that acetylene on decomposition had to be divided among all the atoms present. There were two atoms of hydrogen over in the conversion to acetylene. These practically divided the illuminating value of the compound by 2; and this was why the enrichment value of butylene was exactly the same as that of acetylene. Taking Mr. Young's oil gas and Mr. Methven's water gas, among the hydrocarbons present there was a large proportion of butylene, and some of the higher members of the ethylene series; and these, in decomposing, gave two or more molecules of acetylene at the moment when luminosity was reached. He must apologize for his long explanation; but Mr. Foulis's question had been the cause of it. He hoped his remarks would also make clear to Mr. Wright and Mr. Ball why it was that they had with benzine so much higher enrichment value. The illuminating value of benzine when burnt alone, would be found to be about 700 candles—in fact, experiments pointed to that; and benzine, consisting as it did practically of three molecules of acetylene wrapped into one, would be practically three times the value of acetylene, or just a little more than 700.

Mr. Wright said the results he mentioned just agreed with what Professor Lewes had stated.

Professor Lewes said benzine vapour then would have an illuminating value, for every 5 cubic feet, of about 700 candles. The enrichment value of it would be about three times 1·30—that was to say, the enrichment value would be just about three times what was obtained with acetylene, with a small increase, perhaps, on account of the thermal changes that were taking place during the decomposition. He must again apologize for these lengthy remarks; but he thought, if they had followed the theory he had put forward, it would answer the questions asked by both Mr. Botley and Mr. Glover. The richer they had a coal gas, or the higher its illuminating power, the more they had of the higher members of this particular series present; and the enrichment of (say) a 15-candle gas by a cannel gas would bring about very much the same sort of phenomena as mixing a gas containing the higher hydrocarbons, such as butylene, with a poor coal gas. As to Mr. Glover's suggestion, that a burner might be made to bring out better the enrichment value of acetylene, he did not think it would be carried into effect. The reason for its low enrichment figure would still exist; and though they might increase the illuminating effect obtained from it, by using (say) a regenerative burner, still this burner would also increase the enrichment value of any other hydrocarbon. Consequently, it would be merely a *pro ratâ* increase, and would not bring the acetylene any more forward in the race.

INSTALLATION OF CARBURETTED WATER GAS AT TOTTENHAM.

By A. E. Broadberry.

The prominence which carburetted water gas has attained in the economics of the gas industry of this country is now so considerable, that the author willingly acceded to the request made by the Council of the Institution that he should lay before its members some account of the early experiences gained during the working of the installation at Tottenham. It is first necessary to mention the various considerations which led to its adoption, and also those which decided the form of apparatus to be erected.

Though the Company's Chief Engineer—Mr. W. H. H. Broadberry—had for some time entertained a strong conviction that carburetted water gas would prove of great value to the gas industry on this side of the Atlantic (and as far back as 1891 recommended its adoption), it was thought advisable to await proofs of working at Beckton before deciding the matter. For this and other causes, extensions were delayed. However, during the Christmas week of 1893, notwithstanding that every retort on the works was in action, it was impossible to gain stock in the holders; and though this was not actually decreasing, a fog for a day or two would have placed the works in extremities. Under these circumstances, it became imperative that something should be done; and consideration was given to various kinds of coal-gas settings, including those on the inclined system. Carburetted water gas, however, presented inducements which appeared to outweigh all other forms of gas-manufacturing plant.

The first and great need was for a bulk producer; and the readiness and facility with which water-gas apparatus could be operated made it most suitable in this respect. This process also gave promise, which it has since fulfilled, of being the most easily controlled and the cheapest of all enriching methods; and since the tendency at the present day is, very rightly, to increased illuminancy, even for works not positively needing an extension of the bulk-producing plant, as was the case at Tottenham, it will be found a great boon as a very reliable, immediate, and obedient enricher.

Besides this, events of recent years have gradually paved the way for its more general adoption. To begin with, the cost of labour has increased; and as this is a comparatively small item in carburetted water gas, the fact scored a point in its favour. In this connection, it should be mentioned that the laboriousness of work is by it reduced to a minimum. The Act of Parliament for the Equalization of Railway Rates gave the railway companies an opportunity of which they took advantage. The freightage on coal and coke has of late years been considerably increased; and since the manufacture of water gas, as compared with that of coal gas, means a lessened requirement of the one and an increased local outlet for the other, this also gave it a helping hand.

There is yet another important transpiration which has, above all, favoured its introduction. Oil has of recent years been steadily falling in price; and an increased demand is likely to bring about still lower figures. That "demand and supply regulate prices," is a well-known economic axiom; and where the supply is unlimited, as seems to be the case with petroleum, demand cannot overtake it, and prices cannot permanently be raised, though great efforts will probably be made to advance them. On the other hand, increased trade means the introduction of increased facilities, which will lessen the cost of the various items that go to make up its price. The effect of competition, brought by a rapidly developing market, will also aid in this result.

Oil has, of course, to be brought to the spot in most cases by railway; and this may discount, to some slight

extent, what has been said as to the reduction of railway traffic. But, for 17-candle gas, 10 tons of oil replace 100 tons of coal; thus reducing the make of coke for disposal by 45 tons, to which must be added 20 tons required for the manufacture of water gas in proportion. Therefore 10 tons supplant 165 tons; and as the substituted material is easily and cleanly handled, the labour and worry of the incidental traffic is very considerably reduced.

These various considerations led to the adoption of water gas. The question as to the form of apparatus had next to be considered. For wide experience, it was necessary to look to America, where carburetted water gas has been attaining success during the last quarter of a century. It was found that the largest concern there, which not only contracts for the erection of complete plant, but owns and controls about forty different works, so far prefers the double superheater type as to adopt it in all extensions and renewals. The fact that all the installations on this side were also of the above-mentioned type seemed to point to it as being preferable to what is known as the "combined" machine. That the gas should be permanent it is most important to provide ample fixing surface.

With the double superheater type, the carburettor is (say) 18 feet, and the superheater 25 feet in height—equalling together 43 feet. The oil is sprayed in at the initial point, where it is met by the nascent water gas; and the whole length of both vessels is available for "fixing" the oil vapours.

In a combined setting, even if a vessel 43 feet high were used, the oil is introduced several feet up; and the active fixing surface is consequently reduced. It is a height, however, to which one hardly cares to go, seeing that the stack-valve, which has to be opened and closed at the beginning and end of each run (and may need attention during the run), is situated at the top. The usual height above the oil-spray is about 20 feet; and the total height about 32 feet.

Since these matters were under consideration at Tottenham, alterations have been made in this type of machine, by which, if desired, the water gas may be carried to the top of the superheater, and the oil there sprayed in so that the whole length of the superheater is used as a fixing chamber—the gas, when working in this way, being taken off from the bottom instead of the top. This seems to necessitate a complication of valves, ducts, and oil-sprays (confusing the operator), to attain an end which the double superheater gains without departing from simplicity of construction. A minor point of some importance which may also be claimed for the double superheater, is the placing of the oil-spray centrally, so that an even disposal over the top of the checker-work is obtained—a position which is not available in the combined machine. It is possible that, on extremely limited ground space, one would prefer having the combined setting to none at all; but where room can be found for the double superheater, it seems to be much more desirable.

Tottenham was the first medium-sized works in England to adopt water gas; and the installation at present completed consists of two so-called 6 ft. 2 in. settings, equal to a capacity of about 750,000 cubic feet per day. They are the smallest-sized machines yet worked on this side of the Atlantic. The custom of describing the size of the apparatus by the outside diameter of the shells is not a good one, as the efficiency or capacity of the plant is dependent on the internal area. Those in question would, therefore, be better described as 4-feet settings instead of 6 ft. 2 in. ones. The engines, fans, boilers, oil-tanks, pumps, buildings, foundations, &c., are so arranged as to allow of a subsequent addition of two other similar settings; making the total capacity, when finished, equal to (say) 1,500,000 cubic feet per 24 hours.

The general arrangement of the Tottenham plant is so similar to others previously described in papers read before the Institution, that it is unnecessary to recapitulate it. The essential difference between the Beckton or the Kensal Green plant (except as regards size) is the provision for making at will down-runs as well as up-runs. By a simple system of connections and change-valves, steam can be admitted to the top of the fuel-bed, and water gas made by a downward flow in the generator, from the bottom of which vessel it would pass to the top of the carburettor, to be there enriched with the oil vapour in the usual way. The benefit of this occasional change is obvious. The constant introduction of a large volume of steam to the bottom of the fuel-bed naturally damps down and cools it; and during the "blows," the heat is but imperfectly recovered, as the fire does not readily work backward against the blast. The effect of this cooling is not only to very materially reduce the effective depth of the fuel-bed, on which depends the reduction of carbonic acid to carbonic oxide, but it also causes the formation of a very considerable surface for condensation of steam.

When a down-run is made, the flow of gas from the hot part of the fire returns heat to the deadened fuel below, and the whole depth again becomes active. The efficiency of the generator (as regards quantity of gas produced) is considerably augmented by this arrangement. The change is effected by means of a hand-wheel on the pinion-shaft of the upper valve, which is coupled to the lower by means of a chain, so that as one falls the other rises—counterbalancing each other. The steam current is simultaneously reversed by a three-way cock, worked by a sling attachment from the rack of the lower valve.

The only other portion of the apparatus which needs special mention is the relief holder. For this purpose, an 80-feet holder, having a capacity of 180,000 cubic feet, was available, since it was too small and too light for ordinary distribution purposes. Its size is more than is absolutely needed (the usual variation being fully covered by 5000 cubic feet); but its extra capacity is useful in the event of a stoppage of the exhauster, as well as for providing a stock of gas for continuing the enriching, should it be necessary to suspend water-gas making for an hour or two. An ample relief holder would also, in small works, allow sufficient gas being made in one or two shifts to last during the 24 hours; stock being in this way accumulated, to be drawn upon during the period when the apparatus was lying off. The proportionate mixing of the water gas with the coal gas throughout the whole of the 24 hours would thus keep the enrichment of the latter regular. The only disadvantage would be a slight increase in the fuel account.

One or two words will not be out of place here on the subject of working without a relief holder. There is no doubt that, by very careful manipulation, such working is possible; but not only are the advantages just mentioned entirely missed, but very special arrangements must be made in connection with the exhauster, to successfully deal with the varying gas production. In addition to being intermittent, it is constantly changing in volume during the whole of the run, owing partly to the gradual cooling of the fire, and partly to the stoppage of the oil in time to allow of the passage of all carburetted gas through the seal before the cessation of gas making. With the best-designed scheme, there seems to be involved a risk of carbonic acid and nitrogen being drawn through the seal from the spent blast gases, unless the exhauster were entirely stopped during the blows; and this for periods of four minutes out of each eleven is scarcely practicable. Even if the gas-exhausting were perfectly done, the coal gas would get a mixture varying in richness during the run of gases; and during the blow, and still longer during clinkering, the coal gas would pass to the holders quite unenriched. Diffusion therein would probably thoroughly take place; but absolute and proportionate mixing in the purifiers or gasholder inlet-main seems more certain. It is assumed in these remarks that only one water-gas setting is in use, which would probably be the case in most moderate-sized works. If two sets were in operation, the arguments would be lessened, but not destroyed.

Arrangements have been made for the delivery of oil in tank barges to a wharf on the Lea (situated about three-quarters of a mile from the works), whence it will be pumped through a pipe-line to the storage-tanks.

The following items give the cost of the plant:—

Houses, foundations and plant, including boilers, hydraulic lift, engines, blowers, pumps, exhauster, tar separator, water well, drainage, &c.	£10,041
Two oil-storage tanks, 35 feet by 12 feet (144,000 gallons total capacity), with concrete foundations and pits, 42 feet diameter and 6 feet deep . . .	953
Mains and connections	735
Oil pipe-line, including engine and pump and wharf buildings	396
Total	£12,125

An additional outlay of about £2000 will complete the proposed extension of the plant up to an output of 1,500,000 cubic feet per day.

For purposes of comparison with the cost of coal-gas plant, it is necessary to take into account not only the retort-house, with its retorts and all appliances, but also coal-stores, coal-sidings, coke-yards, condensers, boilers, engines, exhausters, pumps, scrubbing plant, mains and connections, tar and liquor tanks, and also the sulphate works, &c., with accessories for the disposal of waste gases and spent liquor. For a make of 1,500,000 cubic feet per day, the above plant could not be provided for anything near £14,000 to £15,000, and this is independent of the cost of the extra ground space occupied.

Previous papers and discussions have regarded carburetted water gas as being made chiefly for the purpose of enrichment, and for use in sudden emergencies, such as fogs, &c. But it is now an accomplished fact that water gas has been made and distributed in considerable bulk regularly day by day to a large portion of the northern suburbs of London. During the four months' record of working available for this paper, carburetted water gas has averaged 39 per cent. of the total bulk distributed.

The following analyses show an interesting comparison between coal gas and carburetted water gas:—

Description of Gas.	Sulph. Hyd.	Carb. Acid.	Illuminants.	Oxygen.	Carb. Oxide.	Hyd.	Marsh Gas.	Balance.*
Unpurified carburetted water gas	0·4	6·0	8·8	0·5	27·4	32·3	20·5	4·1
Unpurified coal gas (from scrubber outlet)	1·4	1·3	2·3	1·1	5·2	43·0	37·1	8·6
Combined gas delivered to streets, being 35 per cent. of carburetted water gas.	..	..	4·8	0·2	13·8	41·1	32·7	7·4

* Probably nitrogen.

The first and second of these analyses have been made by absorption with the usual reagents, and by calculations from explosion. The reliability of this method has been questioned; but the results are given for what they are worth. The third is a computation, based on the other two. It is given to show approximately what the constitution of the mixed gases would be after complete purification. As a matter of fact, the carbonic acid was not abstracted, although in the quantity given in the subsequent statement, the 6 per cent. has been deducted.

Leaving out, for the moment, the consideration of other advantages, and applying the crucial test of £ s. d. to the working results, the following statement shows the figures obtained during three days on which observations were carefully made:—

Cubic feet of gas made, corrected for temperature, barometric pressure, differential pressure of purifiers (the meter being on the inlet), and for impurities contained	1,104,000 cub. ft.
Average illuminating power	22·38 candles.
Refined kerosene used (·825 sp. gr.; 83° guaranteed minimum flash-point)	3685 gallons.
Do. per 1000 cubic feet	3·34 ,,
Candle value per gallon per 1000 cubic feet	6·70 candles.
Do. per standard burner	1340 ,,
Coke used in generator	18 tons 9 cwt.
Do. per 1000 cubic feet	37·43 lbs.
*Do. for boiler (including breeze made in handling coke)	4 tons 4½ cwt.
*Do. per 1000 cubic feet	8·57 lbs.
Wages, including foreman, and help for sorting ash, &c.	£7 19s. 3d.
Ash made for sale (selling price 4s. 6d. per chaldron)	2½ chaldrons.
Water evaporated per 1000 cubic feet made	10·4 gallons.
Water supplied to scrubber and condenser, and cooled and re-circulated, per 1000 cubic feet made.	57·0 ,,

* In addition to sortings from ash, and all the tar produced.

Cost per 1000 Cubic Feet of 22·38-Candle Gas.

	Pence.
Coke, 46 lbs., at 15s. per ton	3·70
Oil, 3·34 gallons at 2¼d. per gallon	7·51
Labour	1·73
Purification (estimated same as coal gas)	0·56
Wear and tear (estimated)	1·00
Lubricating oils, cotton waste, and sundries	0·12
Supervision (same as coal gas)	0·71
	15·33
Less for ash sold	0·12
Net cost per 1000 cubic feet into gasholders	15·21
Value of 1000 cubic feet in pounds of sperm	76·73
Cost per pound of sperm	0·198

It will be seen that each gallon of oil gives a value of 6·70 candles per 1000 cubic feet; and this figure will be practically constant for all the variations necessary to maintain the coal gas at the desired power. Therefore, dividing the cost per gallon by the candle value, it is found that the cost per candle for enrichment is 0·336d.—a figure with which other forms of enrichment will find it difficult to compete. It is almost unnecessary to add that, since the manufacture of carburetted water gas was commenced, the use of both cannel and carburine has been wholly discontinued.

The average cost of 16-candle coal gas into the holders at Tottenham, taken on the last two years' working, has been 1s. 5·24d., against 1s. 3·21d. for 22-candle water gas. Therefore an actual saving of 2·03d. per 1000 cubic feet is effected on (say) 35 to 40 per cent. of the total make (this being about the proportion of carburetted water gas); and the other 60 to 65 per cent., consisting of about 13½-candle coal gas, needs no other enrichment, and can consequently be made at fully 2d. per 1000 cubic feet less than previously.

In regard to the numerous advantages claimed for water gas, although the whole of them need not be here fully dealt with, those actually realized at Tottenham should be mentioned. They are: An improved coke market; greater facility of controlling illuminating power; cheapness of enrichment; disappearance of naphthalene troubles; and last, but not least, lessened anxiety on responsible officials.

So much for the advantages. Now for the other side. One drawback has presented itself, which, though not of serious import, must not be overlooked. This is the higher specific gravity of the gas, which necessitates an increase in the initial pressure on the street-mains exactly in proportion to the extra weight of gas to be propelled. At first thought, it is likely to be feared that the increased pressure would also increase the unaccounted-for gas. But consideration will show that it would require the same increase of pressure to get the usual quantity through any leaks as it does to get the usual quantity through the burners; and, after all, the actual percentage of leakage is an unknown quantity in unaccounted-for gas. But though there probably is no extra leakage caused by the greater pressure needed, the weight of the gasholder places a limit upon the available amount of this; and if the delivery mains were already so inefficient that with coal gas the full gasholder pressure was being worked on the district, a change to water gas would make the much-needed enlargement imperative. Under such circumstances, this could not be considered undesirable.

In conclusion, it may be stated that the impressions made by carburetted water gas at Tottenham are so favourable that the time is looked forward to when not only the present installation shall be completed, but when another house shall be erected on the space now occupied by the coke-yard; when all the coke produced shall be used in the manufacture of gas; and when, for every ton of coal brought into the works, about 34,000 cubic feet of gas shall be sent out.

Discussion.

Mr. W. King (Liverpool) said he was exceedingly glad to find that the author confirmed the opinion he had himself formed from the short experience he had had of the manufacture of carburetted water gas. It would appear, from the experience of The Gaslight and Coke Company, and of Mr. Stelfox at Belfast, that those who adopted this method of manufacture seemed to derive increased satisfaction from it the greater the quantity made and the longer acquaintance they had with it. At Liverpool, about three years ago, it was necessary to make an extension of plant; and at that time carburetted water gas was brought under his notice. Through the kindness of the Engineers of The Gaslight and Coke Company, he had an opportunity of looking at the plant, both at Beckton and at Kensal Green; and he was so much impressed with the many favourable points of the process, that he induced his Directors to let him go to America for the purpose of seeing the manufacture at home, in cities and towns with populations varying from 200,000 or 300,000 up to a place like Chicago, with a population of about 2,000,000, which were lighted entirely on this system. He would take this opportunity of returning thanks to their American brethren for the kindness with which he was received; and he believed his experience was similar to that of other engineers, who found they were treated in America with the greatest kindness and hospitality. Every opportunity was given him to investigate the matter, and to look at the details of the manufacture. He came back exceedingly impressed with what he saw; and he could not shut his eyes to the facts and figures given to him, or to the experiments which he personally was allowed to try.

It was important to know whether, if they burnt the American gas with English burners, the result would be such as was said to be obtained; and he found this to be the case in those instances where he had the opportunity of making experiments. The up-shot of the whole matter was that, on coming home, he advised his Directors to erect a plant for the manufacture of carburetted water gas, adopting the double superheated principle, which he found was really swallowing up all other methods in use in America, although he saw other systems in operation. Some time was necessarily occupied in erecting the plant, and they had but been a few weeks at work; so that his experience was only limited. But, as far as they had gone, they could confirm those who had tried it elsewhere. Many advantages had been dwelt upon by the author of the paper, and on different occasions by others. But certainly, quite independently of the economical production, came the questions of finding a market for coke, and being more or less independent of cannel proprietors, and the possible solution of the labour question. For, however amicable the relations might be between employer and employed, they would all agree that, if they could use 20 instead of 200 men, it was in every respect very much better. In Liverpool, they were making about 22-candle gas; and he should like to ask the author the exact description of burner used at Tottenham for ascertaining the illuminating power. If he (Mr. King) remembered rightly, the figure given was 22 candles in a batswing burner. But what batswing? A variety of these burners were used, and a variety of results obtained. In working these out, it was important that they should all be on the same basis; or, if they were not using the same burner, they should be able to allow for the difference. If the burner employed in Liverpool gave better or worse results than those obtained at Tottenham, it was desirable that they should know what the differences were. Their burner was Sugg's No. 7 steatite batswing, which he believed was the standard burner in London when cannel gas was made there. This had been adopted for many years in Liverpool; and, therefore, in testing the gas now manufactured, he had used that burner. He did not say that it gave the highest results; but, at all events, it enabled them to compare those obtained over a long series of years, with the carburetted water gas now being manufactured. As the manufacture had only been carried on for a few weeks, they had not yet the full information they would get by more extended experience. But, on the whole, as far as they had gone, he should generally confirm the figures Mr. Broadberry had given.

Mr. W. Foulis (Glasgow) said his experience of water gas had been on a comparatively small scale. They had had running for something like 18 months plant which made about 300,000 cubic feet; but his idea was only to use the gas for enriching coal gas. It so happened that they could get, at a cheap rate, coal which would produce 16 or 17 candle gas; and what they wanted was to save the expense of purchasing cannel to raise this gas up to 21 or 22 candles. Generally, they found that the higher the quality of the water gas, the more economical it was in enriching poor gas. Until a few weeks ago, they had made water gas of as high as 50-candle power. They were now about to try experiments with oil gas; but until these were completed, he could not make any comparison between the respective merits of the two systems. He found that, for enriching purposes, it made a great difference at what points the gases were mixed; and he found the best plan was to mix them soon after they were formed, and while they were at the temperature of the hydraulic main. Practically they were now mixing them at the outlet of the hydraulic.

Mr. Charles Gandon asked the illuminating power of the mixture, using 35 to 40 per cent. of the water gas.

Mr. J. Methven (Beckton) said the principal matter to which he should now like to refer was the application of water-gas plant to moderate small works, situated as those were at Tottenham, where the cost of coal delivery was rather high. Undoubtedly, the introduction of carburetted water gas there would be attended with satisfactory and economical results. The Gaslight and Coke Company, at Beckton, who were the pioneers in the adoption of water gas in this country, found by experience that it was more profitable to use the carburetted water gas only as an enricher. Having facilities for receiving coal at a cheap rate, manufacturing water gas under other conditions was out of the question. With regard to the analysis of the unpurified water gas, it did not distinctly state that this was the result of the gas made at Tottenham. If it was, a little latitude ought to be allowed for the short time the apparatus had been at work. But he noticed that there was a production of 6 per cent. of carbonic acid. In practice, they found this an abnormally high quantity. Good working resulted in a very much lower percentage—nearer 3 per cent. If this 6 per cent. were maintained, it would be useless to estimate the purification charges as being only equal to that of coal gas; for they would be nearly double. With regard to another point, he had heard from a very good authority that, when any company contemplated obtaining powers for extending their works, the Board of Trade were looking into the question of the supply of carburetted water gas; and he thought the day was not very far distant when the quantity of water gas supplied to the community would be restricted to a certain percentage on the total make. He noticed that Mr. Broadberry was using 30 or 40 per cent., which was rather a high proportion. He believed the idea actuating the Board of Trade officials was that of restricting the amount of carbon monoxide in the gas delivered. So that it was not at all improbable that, as time went on, the desire to take advantage of the introduction of carburetted water gas would be met with a restriction of the quantity allowed to be delivered.

Mr. J. L. Chapman (Harrow) said, in reference to the statement that increased pressure was needed for the supply of this gas in the Tottenham district, he should like to ask Mr. Broadberry what the old pressure was, and what was the pressure now with the mixture. Mr. Methven referred to moderate-sized works, and to water gas being a useful adjunct for the supply of gas in bulk in such places. Of course, there were two sides to the question—enrichment, and the supply of gas in bulk. The paper before them dealt more especially with the latter. He was in a very peculiar position—having to supply gas about nine miles from his works, and having no manufactories; so that he had to deliver his coke over the same ground as the gas. It seemed to him that, if carburetted water gas proved to be such a success as it appeared to be at Tottenham, for smaller works still, where they were dependent, for the carriage on the railway companies, who charged the highest rates they could—the rate at Harrow being something like 10s. a ton from the pit—it would be very helpful indeed. In many small works, the increase of coke was rather a nuisance than otherwise. With 75 per cent. of coke, he thought he should gain more than with 100 per cent., allowing for the cost of handling and delivery. They must thank Mr. Broadberry very much for the careful manner in which he had prepared his paper.

Mr. A. C. M'Minn (Kensal Green) said the question of the applicability of the system before them to small or inland works using the gas in bulk was answered in the case of Kensal Green. As Mr. Methven had pointed out, at Beckton, on account of the cheapness of the coal delivery, it did not answer to produce it in bulk. But at Kensal Green, where there were heavy charges on the carriage of coal, it was found that carburetted water gas could be supplied in bulk at a lower figure; and it answered their purpose to use it—a considerable percentage being made there as compared with the total production. He considered it would be very inadvisable, for several reasons, to attempt to do without a relief holder. He thought it would be found that, in making sufficient oil gas in one shift to last 24 hours, and storing it for working out as required, would not be economical, as the gas depreciated more when stored pure than after it was mixed with the common gas. It would be preferable to mix it with the coal gas at the outlet of the hydraulic main, as suggested by Mr. Foulis, if it could be properly measured, and the system of purification allowed of this. The relief holder was very useful in case of accident, or of a breakdown in the purifiers. If such a thing happened, all one had to do was to work into the relief holder, and wait till it was safe to get in among the purifiers to make the necessary changes. They always found that, in working one set only, it was advisable to stop the exhauster when clinkering. The figures given as to the cost of production agreed pretty closely with those at Kensal Green. Mr. Broadberry said it was only necessary to increase the pressure in the street mains on account of the difference in the specific gravity; but he (Mr. M'Minn) would remind him that this did not deal with the question of governor burners, which would

also have to be altered, in order to allow the proper quantity of gas to pass through. With regard to the question of purification, he agreed with Mr. Methven that the figure of 6 per cent. of carbonic acid was extremely high, and that it would entail quite double the cost for purification in comparison with coal gas. As it was, keeping the carbonic acid down to about 3 per cent., or a little more, the purification was rather more costly than with coal gas. As in the manufacture of carburetted water gas a considerable quantity of tar was produced that was not of much use at the chemical works, it might be of interest to state that, at Kensal Green, the whole of this tar was used as fuel under the boilers, without the production of any smoke; and at the same time the labour of firing was very much reduced.

Mr. W. R. HERRING (Huddersfield) said he had not yet had any practical experience with water gas; but he was anxiously watching it, and even providing for its adoption when he could satisfy himself that it was the right thing. Up to the present, however, he had not been satisfied. He objected chiefly to the method of carburetting it, because he thought the mode of treating the oil in the carburettors was wrong in principle. He was of opinion that, in order to get the best results from the oil, it must be treated fractionally at a constantly increasing temperature from its entrance into, to its exit from, the apparatus. In the ordinary carburettors employed in water-gas processes, the oil entered a hot chamber at the beginning, which, as a consequence of the gasification of the oil, gradually cooled down—this method causing a large deposit of carbon, tar, and pitch. If the oil gas were made properly, there need be no liquid residue whatever, and not more than 3 to 5 per cent. of solid carbon—all the rest being given off in gas. At present, he could not say that all carburetted water-gas methods accomplished this; and, until some better systems of carburetting were introduced, he should continue to watch with considerable interest the experiments of others.

Mr. A. F. BROWNE (Rotherhithe) asked what was the particular advantage claimed from the adoption of the double superheater type of apparatus, as compared with the combined setting. He said the author appeared to contend that an advantage would be obtained by the increased fixing-surface provided; and he (Mr. Browne) should like to ask him how his results, as regarded the average illuminating power of the water gas and the candles per gallon of oil, compared with the working at Beckton. Did he, by the adoption of this double superheater method, get a higher average of illuminating power, or did he use less oil? And was it really necessary that this fixing-surface should be farther extended? He quite agreed with what Mr. Herring had just said. It seemed to him to be wrong in principle that the oil should be run on the highly-heated bricks, which must necessarily lead to a large proportion of it being broken up into very poor gas. It was rather striking to hear Mr. Foulis say that he produced water gas of 50-candle power; for he believed 22-candle gas was what most of them made, on the average. Did Mr. Foulis get a large quantity of residual oil, or was Mr. Broadberry's gas unnecessarily impoverished? The author claimed an advantage due to the fact that he could reverse the current through his apparatus; and he (Mr. Browne) should be glad if he would point out what was the advantage. If he understood Mr. Methven aright, the percentage of carbonic acid in Mr. Broadberry's gas was unusually high. But Mr. Broadberry claimed that the effect of reversing the current would be a reduction in the quantity of carbonic acid. What, then, was the advantage he gained? Did he use a smaller quantity of coke per 1000 cubic feet?

Mr. A. MEAD (London) said there was one matter in the paper to which he took special exception. The paper was a statement of facts as to what had occurred at the author's own works, and could not be contradicted. So far as he (Mr. Mead) could see, the results were almost identical with those obtained at Belfast and other places with the same type of apparatus; and the improvement in this particular type of plant during about the last twelve months seemed limited to a difference of only a little more than ½ lb. of fuel per 1000 cubic feet of gas made—viz., Belfast, 38·14 lbs.; Tottenham, 37·43 lbs. But with respect to the relative merits of the double superheater and the combined superheater, which was the point to which he wished to draw special attention, Mr. Broadberry gave, as a reason why, in his opinion, the former was supposed to be the best, the case of an American Company owning a large number of works which did not adopt the combined superheater, but continued to use the double superheater. He (Mr. Mead) knew what Company was referred to; and he could only say, with respect to the combined superheater, of which he had some knowledge, that it could be best and most economically used in connection with a patent which that Company could not adopt, as all rights in it belonged to a competing Company. He knew of several cases in America where plants of the Tottenham type, with double superheater, had been used with a fuel account for the generator of 46 lbs. and upwards per 1000 cubic feet of gas made; and upon the introduction and substitution of the principles embodied in the patented combined superheater, this fuel account had been reduced to less than 30 lbs. per 1000 cubic feet. No difficulty was found in obtaining this result with a combined superheater on the other side of the water; and he had no doubt that the same would be more than confirmed in this country in the course of a few weeks with a plant now in course of erection. He might also say that the patented plant to which he was referring possessed other advantages over the double superheater recommended by Mr. Broadberry. With respect to the introduction of the oil, and its being equally sprayed at the top and in the centre of the carburettor, the same remark equally applied to the patented plant; the point of admission, however, being different. He thanked the President for according him the privilege of taking part in the discussion. He could say much more about these water-gas plants; but it was neither the time nor the place to refer more particularly to the merits of rival apparatus.

Mr. BROADBERRY, in reply, said he was very pleased that his paper had brought out so good a discussion. The burner he used was an ordinary No. 1 "London" Argand. He did not consider it was the most suitable one for the purpose; but it was on the photometer, and so they used it. Mr. Foulis had alluded to mixing the gas at the hydraulic main. Of course, by this means there would be the advantage of extracting a large portion of the carbonic acid in the scrubbers. With their method at Tottenham, the water gas was put in at the inlet of the oxide purifiers, not at the lime purifiers; so that they were not extracting the carbonic acid in any way. There might be some advantage in passing the water gas through the scrubber, so as to extract the carbonic acid; but at the same time there was the possibility, on the other hand, that some illuminants might also be extracted. This brought him to the question of gas purification, the estimated cost of which had been queried. He had stated in the paper that the water gas was not passed through the lime purifiers. As a matter of fact, purification was now costing less than with coal gas only. Not only that, but the 6 per cent. of carbonic acid mentioned had been deducted from the quantity of gas made, from which the calculation of the cost per 1000 cubic feet had been made. So that, if the calculation had been carried out on the larger quantity, including carbonic acid which had actually gone out into the mains, the cost per 1000 cubic feet, instead of being 15·21d., would be 14·43d.

The PRESIDENT: Why, then, deduct it?

Mr. BROADBERRY said because the water gas supplied to the photometer was purified through an experimental lime purifier, so that the carbonic acid was taken out from it. He thought, as the candle power was given of the completely purified gas, it was fair to correct the bulk also.

Mr. FOULIS remarked that it was surely not fair to charge people with carbonic acid.

Mr. BROADBERRY said that, as long as it was sufficiently carburetted to give them 16½-candle gas, he did not see that it would matter to them whether it was carburetted hydrogen or carbonic acid. With regard to Mr. Gandon's question as to the illuminating power of the mixed gases, the average they were sending out during the period of the observations was 16·37 candles—the standard being 14 candles. The coal gas, by itself, had an illuminating power of 13·4 candles. The 6 per cent. of carbonic acid was certainly very high. But, as stated in the paper, the analysis was made by absorption; and he did not believe in the correctness of absorption tests for carbonic acid. He had tried it with the Harcourt test against the absorption test; and then it was more like 3 per cent. than the

6 per cent.—it was about 3½ per cent. by the Harcourt test. With regard to the proportion of water gas they were sending out, the average during the whole time of working had been 39 per cent. At times it had been up to about 45 per cent.; and it would probably be again, because, as the requirements fell off, they were shutting down the coal-gas settings, and keeping one set of water gas in full work. With regard to the increase of pressure, he might say that they had to deal with a very large district, similar to Mr. Chapman's. Some portions were a long way (about five miles) from the works; and, unfortunately, they had some very small mains, and already had a rather high pressure on them. They were working at 4 inches; and they increased to 4½ inches. This was about in proportion to the difference in the specific gravity of the gas, which at present was a little over ·500. This included the carbonic acid. It was very desirable to use relief holders; though there were some places in America where they worked not only without a relief holder, but without an exhauster, and had the entire pressure of the purifiers on the plant. He did not think it was any more desirable to do this with a water-gas than with the coal-gas setting. With regard to the lamp-governors, it had been found necessary to adjust them to the heavier specific gravity of the gas, to give 5 or 6 cubic feet per hour as the case might be. Mr. Herring had referred to a deposit of tar or pitch. He understood him to mean in the carburettor. They were using kerosene; and the total amount of tar was very small. The whole would not exceed 1 per cent. of the oil. It was impossible to say what carbon might have formed during the run; but it always burnt off during the "blow." Mr. Browne had asked a question as to the advantage of the double superheater as compared with the method adopted at Beckton. Of course, at Beckton and Kensal Green they had a double superheater, in practically the same form as they had at Tottenham; so the comparison between the oil results would not indicate anything. But, as a matter of fact, he believed their oil results were very much the same as those of The Gaslight and Coke Company. The reversal of the current in the generator added to the efficiency of the machine per square foot of area. Mr. Mead had stated that some works in America were using 46 lbs. of coke per 1000 cubic feet of gas made; and that, by changing to a combined machine, they worked the fuel down to below 30 lbs. He (Mr. Broadberry) could simply say that, if they were large machines, and used 46 lbs. in the generator, it would be an exceedingly high figure. At the present time, they used a total of 46 lbs. at Tottenham, including coke for the boilers. But theirs were small machines; and they did not consider they had yet arrived at the best fuel figure. There were a great many works in America using the double superheater type at considerably less than 30 lbs. of coke per 1000 cubic feet in the generator.

SLOPING RETORTS.

By J. Husband.

Some time back, the opinion was expressed that publication of the results obtained in practical experience with the non-mechanical system of gas stoking adopted by the Brentford Gas Company would be of great value and interest. At the time, however, it was thought that, as the system had not had an exhaustive trial, it would be better not to say much about it. But now, having had a fuller experience (dating back, indeed, since their very inception, and long before any patent was taken out or applied for), the author has pleasure in laying before the Institution the results of their working at Brentford.

On Oct. 22, 1889, the first installation of retorts arranged for the simplified manner of charging and discharging by gravitation was put into work at the Company's Southall station, where they were christened "Slopers" by the men; and now, five years after, it is possible to furnish by this paper a reliable statement of their capabilities.

At the meeting of the Institution in 1891, a paper was read by Mr. M'Minn, in which were forecast the probable effects of the system; and now, after much larger experience, the author is in a position to assert that these assurances have been fully realized, and that, in their perfect form, inclined retorts have been proved to be great reducers of hard, wearisome toil, and great economizers of time, labour, and capital.

There have been difficulties to contend with in such a radical change of working—difficulties only paralleled, probably, by the substitution, years ago, of the oxide process for removing sulphuretted hydrogen, for the foul wet lime process of purification. But in that instance the labour was not so heavy as it was unhealthy and offensive. With this process of carbonizing, the heat is reduced, and the toilsome, exhausting labour has gone, like luted lids and open firing, into the limbo of past processes, never to return. The change from the old and tried system of hand stoking, with a trained gang of good stokers, to this plan of simply pulling a lever and charging coal from a hopper into the retort, in a perfectly regular layer of any required thickness, while on opening the lower lid the coke falls out on the coke floor, was so great an innovation, that hesitancy in its general adoption cannot be considered surprising. Perfecting the work in the retort-house means good dividends, cheap gas, and contented consumers.

The energies of many workers had, by dint of trial, hard work, and hard thought, placed carbonizing upon a footing which was considered—and still is by some—to be beyond improvement. Unfortunately, one important failure arose. Success depended upon a trained class of men, who had the heat and burden to bear, and who considered that this work was not adequately remunerated. A period of great tension followed, from the years 1888 to 1890, culminating, at Bristol and Leeds, in serious disaffection. All these troubles induced thinking men to reflect how far they could be independent of the skilled stoker.

Complicated and expensive machines have been tried; but these have the radical evil that their mechanism has to connect with, or be inserted into, a retort which, from scurf, settlement, or warping, may deviate considerably in shape. These things, coupled with the possibilities of breakdowns, were all grave difficulties in the way of mechanical stoking. Its successful operation, too, depends upon more highly skilled men, less easily replaced than stokers; so that the suggestion of a plan affording independence of any class of worker was too great an innovation, and too radical a change, not to evoke considerable criticism.

Inclined retorts simply deal with the carbonizing of coal; all else is unaltered. Given a retort charged with coal of a certain quality, and given a certain heat, the make of gas, the candle power, and the coke must be the same.

From the outset, it was pointed out that the charges of coal must be burned off; for, unless they are, the coke sticks up in the retort, and tar drips copiously from the mouthpieces. If this is properly done, then with this system of stoking one has a method which is unequalled in ease of working, requires no teaching, relieves the toil of the labourer, assures the proper amount of coal being in the retort (a heavy or light charge making no difference to the operator), saves time in foggy weather, and from which it is easy to turn out a heavy make. Above all, the author is able, after five years' working, to make the bold statement that there are no objections which can be urged against it. During this period, many alterations have been made; points which seemed essential having been adopted or rejected, until the fittest have survived.

The Brentford Gas Company have still some horizontal settings at work; so that the worker can judge for himself which he prefers. The result is that it is considered a favour to be allowed to work the "slopers;" and in consequence, the most steady men are given the work as a reward. They never strip for their work—they always wear their flannels. The men who work on "slopers" would feel it a hardship if they were sent to ordinary stage work. The Company can also afford to pay them well. The charging-stage is neater and cleaner than with horizontal work. It is hardly possible for a hundredweight of unburned coal to go out with the coke in a twelvemonth. It must go through the retort; it cannot be spilt on the stage, and be mixed with the coke or breeze. There is no breeze produced for sale from a properly controlled inclined-retort house.

Visitors have often asked whether the retorts were really at work; for, since the faced mouthpieces are not injured with drawing-rakes or scurfing-bars, there are no leaky lids as in the old settings. Scurfing is seldom necessary, and takes but little time. Under the horizontal plan, the scurfing was heavy work, and damaging to the retorts, If neglected, there was the liability of the scoop to jamb and throw a heavy strain on the stoker; and if the charge

had swollen, he could not get his rake over it. So that, in straining to keep up with his mates, retorts and mouthpieces alike suffered.

On the "slopers," each man has his own work; and there is far less worry and stress. The process is almost automatic. The hot coke falls out readily; but should it stick, a touch frees it, and it falls unaided into the furnace for firing up as required. The men have often been timed (without their knowledge), and have been known to draw and charge 32 mouthpieces in 10 minutes; or, including the throwing back of the coke, 25 minutes for the whole operation. During this 25 minutes, 4 tons of coke had been dealt with, and 6 tons of coal put in the retorts by one man in level and full charges. The charger does his work practically as fast as the retorts can be drawn. The whole draw is completed in half an hour; the remainder of the hour being rest-time. On one occasion, as a trial, the men were allowed to do the two draws (of 64 mouthpieces) at one turn; and they did the work under an hour. The men recognize, indeed, that they have, on an average, 30 minutes' rest on the "slopers," as against an average of 20 minutes' rest on the horizontals. Very often the men on the latter take, with all their endeavours, three-quarters of an hour to complete their draw.

The work on "slopers" is altogether easier; since, while set gangs are not required, less mutual irritation and friction arises. This is a great contrast to the horizontal plan, where the gang on one side must keep pace with the gang on the other; and hence mutual recriminations often occur. The make of liquor and tar remains the same.

The cost of adopting inclined retorts is not greater than with horizontal settings. In relation to this, it may be well to give actual experience. An estimate was made of the cost of renewing this year the old horizontal settings in No. 4 retort-house at Brentford. An estimate was also made for the erection of 14 sets of "slopers" to carbonize 125 to 130 tons of coal per day—using up all the old fittings, such as hydraulics, ascension-pipes, valves, &c. The profit arising from the working of inclined retorts is such that it was shown that the whole cost of transformation would be covered in two years' working. Is there any other process on a gas-works that can show such a profit? As a result, the Directors have ordered the old settings to be removed from Brentford, where there will soon be only "slopers" at work; and the further opportunity of comparison will fortunately be lost.

The cost of the setting is practically the same as with the old settings. The total cost of a house for twelve sets, which sets will produce about a million cubic feet of gas per day, will be £1600 from the ground-line. Why spend more? The wear and tear is much reduced. Why is the system not more generally adopted? Its working can at any time be inspected, and the results tested; while engineers can profit to the fullest extent by the experience gained at Brentford, and know within a few pounds what the cost of any installation would amount to.

The following is a description of the plant as it is now in operation: The coal is delivered by a grab crane, from store or barge, at a cost of 2d. per ton, into a hopper which allows the coal to fall through a grating, where the large lumps are retained and broken by a hammer. Thence it passes to the elevator boot, from which it is lifted by buckets to a conveyor trough, which runs over the whole length of the settings. In this trough, travelling scrapers draw the coal over the hoppers, which are placed over the upper or charging ends of the retorts. At first, these scrapers gave considerable trouble, as they cut into the trough, and made such a shrieking noise as to be unbearable. But in 1891 they were reversed, and supplied with an oak backing, which completely cured the evil. This made such a difference in the wear of the trough, that a duplicate one (which, anticipating wear, had been provided) was taken away, and used for the next house. In the bottom of this trough, over the store hoppers, there are slides, which are opened to allow the coal to drop into each empty hopper as required, until all are filled. In the next extension at Brentford, provision will be made for a barge-load (or, say, 100 tons) to be stored above the settings ready for charging.

Under the store hopper are two measuring hoppers to each setting, which can be adjusted so as to vary, as required, the amount of coal used for the charge; this adjustment being made by the foreman or the operator. Each hopper is provided with a top and a bottom valve, controlled by a lever from the stage, and from which the coal runs in the operation of charging the retort. The movable shoot, which connects the retort to the hopper, is drawn under and connected to the empty mouthpiece; and by simply pulling the lever, the retort is charged—the flow of coal being regulated by a brake or check on the bottom of the shoe. As soon as the coal has run into the retort (it takes about eight seconds), the shoot is pushed on to the next retort, connected up, the lever drawn, the retort charged, and so on to the end.

The operation of charging has been so perfected that there need be no imperfectly charged retorts; the coal being laid in an even thickness in tops, middles, and bottoms. It has been stated that many modifications have been tried in the method of charging "slopers," and that many difficulties and failures have occurred. After a little practice and two test charges, a guaranteed result can be obtained by the use of any coal—putting in perfectly even charges the whole length of the retort, and better than can be done by hand.

So far the charging only has been dealt with. Now comes the essential part of gas making—the carbonization of the coal. The charges are burnt off in six hours—that is to say, one retort, 20 feet long, will carbonize, on an average, 30 cwt. of coal in 24 hours. The carbonizing-books show that this is the average for weeks together. But, to effect this, good and steady heat must be regularly maintained—not up to melting-point one day and down to tar-distilling temperature the next. A simple form of regenerator setting is used, which has been modified and improved until the heats are now under perfect control, for the whole length of the retort, by means of dampers, which do not require adjusting for weeks together, except during the Sunday stoppage. It is found that by increasing or diminishing the supply of breeze during firing, the heats may be easily kept under proper control when once the dampers have been adjusted.

The firemen bar-hook every four hours, and clean each fire once in 24 hours, by driving in spears on a drip-plate, and by simply dropping out the lowest 6 inches of clinker ash; refilling the furnace at the next draw from the top retorts by means of the shoot, which is placed so as to lead the falling coke into the furnace mouth. There is no breeze now for sale out of the "sloper" houses. The coke, not being broken up, makes but little; and all is required for firing—in fact, sometimes it is necessary to fetch extra breeze from the houses where the horizontal settings are in use.

Now as to the amount of fuel used. All the coke from the "sloper" houses is weighed and sold direct into carts. Taken over six months' work, including Sunday stoppings, &c., the total amount of fuel on the settings of 24½-inch by 13-inch inclined retorts comes out at 8 per cent. In proof, the Company sell (and that is the only statement that can be recognized) out of the No. 2 house, where all retorts are inclined, 12½ cwt. of coke per ton of 20 cwt. of coal carbonized.

Now as to the make of gas and its illuminating power. Fortunately this information can be given with the same coals and working on the same lines as with horizontal retorts. The two systems being in different houses, it has been possible to work the "slopers" alone. In a separate test, 48 retorts, or 96 mouthpieces, produced 501,000 cubic feet of gas, per meter (517,600 cubic feet corrected), or 8080 cubic feet per mouthpiece, for 24 hours. The illuminating power averaged 15·5 candles. The makes have been repeatedly tested; and it is found that, on an average, an extra 100 cubic feet of gas per ton is obtained, due probably to the shorter time occupied in charging—inclined retorts taking 8 seconds, as against the 60 seconds average of the horizontals. With gas at 40d. per 1000 cubic feet, this means 4d. per ton of coal saved.

The cost of working compares as follows:—

Horizontals, 46,000 *c. ft. per Hour.*				*"Slopers,"* 56,000 *c. ft. per Hour.*			
4 scoop drivers, at 5s. 4d..	£1	1	4	1 ganger	£0	6	5
8 stokers, at 5s. 4d. . .	2	2	8	4 men, at 5s. 6d. . . .	1	2	0
2 firemen, at 5s. 7d. . .	0	11	2	1 fireman	0	6	0
2 fire-makers, at 4s. 5d. .	0	8	10	1 boy	0	3	0
1 poker-in	0	4	5	1 pipe jumper	0	5	9
1 breeze boy	0	3	0				
1 coal trimmer	0	4	5				
1 pipe jumper	0	5	4				
20 men . . . . Total	£5	1	2	8 men . . . . Total	£2	3	2
Less . .	2	3	2				
Difference . .	£2	18	0				

With 18 tons more coke per day sold: a saving of 57 per cent.

Now with regard to the cost of construction. The cost of retort-houses may well be left out of the calculation, since this can be made to vary according to the ambition of the designer. It is better, therefore, to limit the estimate to the cost of the settings, stages, and elevating, distributing, and charging gear, including a gas-engine for raising the coal. At Brentford, the gas-engine is worked intermittently; and gas (400 cubic feet, at 1s. 9d. per 1000 feet) is not a heavy item—say 8d. per day.

The following figures give, at present London prices, the practical costs of the horizontal and the inclined settings. It should be mentioned that all the constructive work possible is done on the Company's works, to reduce expense; but any company can do the same :—

Cost of Horizontal Settings.

	£	s.	d.
Main arches, main flues, piers, centres, and fixing	79	13	7
Bricks, retorts, labour	127	9	0
Tie-rods, buckstaves, and fixing	14	0	0
Furnace fittings	13	14	10
Mouthpieces, mains, pipes, and all connections, including the labour for fixing the same complete	151	10	6
Tramways to deliver coal (*N.B.*—No waggons estimated.)	20	3	3
Two stages (both sides).	108	0	0
Total	£514	11	2

Scoops, iron ties, shaft and ties, end buckstaves, abutments £162 4 9
or £514 11s. 2d. + £162 4s. 9d.
12 sets
÷ 2 × 7 mpcs.

Equals—

		£	s.	d.
In 12 sets of sevens, per	mouthpiece	37	14	5
10	do.	37	18	3
8	do.	38	4	1
6	do.	38	13	9

Cost of "Sloper" Settings.

	£	s.	d.
Same items	91	4	11
Do.	131	17	7
Do.	12	2	0
Similar fittings	13	14	10
Do., including coal stops	89	0	8
Hopper	89	1	4
Charging stage £16 11 0			
Discharging 22 1 4			
	38	12	4
Total	£465	13	8

Shoots, chain-belt elevators, &c., and gas-engine complete, £630

Shaft, ties, buckstaves, abutments £182 2 3
or £465 13s. 8d. + £182 2s. 3d.
12 sets
÷ 2 × 7 mpcs.

Equals—

		£	s.	d.
In same rates for "slopers," 12 sets, per	mouthpiece	38	1	11
10	do.	39	1	3
8	do.	40	10	3
6	do.	41	14	10

It comes, therefore, to this—that, when twelve sets are erected at once, the cost, including elevator and engine, distributed over the whole, works out to nearly the same per retort as horizontals. But, taking into consideration that the production of gas is as 4 : 5, and the larger resultant labour saving, a very great economy is attained; the saving in coke alone for twelve beds for twelve months being at least 1800 tons.

It is found that the wear and tear of the elevator and gear is a very small item; having been as yet only about £5 per annum for 20,000 tons of coal. The total cost of delivering the coal in position above the sets ready for charging is about 3d. per ton. As for the retorts, in one house they are, after working for 700 consecutive days, as good as at first, and do not show sign of serious wear.

The foregoing is a fair statement of an extended trial of "slopers"—in fact, the most extended trial yet made in Britain; and, considering the facility of working, the easy control of men, the economy of space, fuel, and labour, the decreased wear and tear, and the increased gas obtained, the advantages are all on the side of inclined retorts, which have fully realized all the hopes formed of them when they were first brought out.

In conclusion, the author desires to add that detailed drawings of the Brentford settings, including overhead hoppers, charging-hoppers, scoops, checks, and other improvements, were got out in 1890, and sent to the Automatic Coal-Gas Retort Company the following year.

The Scotch Oil Trade.—The Scottish Oil Association last week reduced the price of burning oil by 1d. per gallon. They recently advanced it by 3d.; so that it is still 2d. per gallon dearer than it was two or three months ago.

The Specific Heat and Boiling-Point of Carbon have been determined by Mons. J. Violle. Above 1000° C., the mean specific heat of graphite increases linearly with the temperature—thus: $C^{t}_{0} = 0{\cdot}355 + 0{\cdot}0006t$; 2050 calories are given up by 1 gramme of graphite on cooling from the volatilization temperature to 0° C. The temperature of ebullition must therefore be 3600° C.

Artesian Wells in Sweden.—A paper was recently communicated to the Paris Academy of Sciences "On a New Type of Wells in the Granitic Rocks of Sweden," by M. Nordenskiöld. These are artesian wells bored to a depth of from 30 to 50 metres in solid crystalline rocks, in the hope of meeting with water coming through horizontal cracks expected to occur in the mass owing to the variations of temperature suffered by the surface portions. Such cracks supplying sweet water have invariably been encountered at a depth of 33 to 35 metres.

Gas for Railway-Carriage Lighting in America.—The branch works of the Pintsch Gas Company, at Chatanooga (Tenn.), have a capacity to make, compress, and furnish 25,000 cubic feet of gas daily. The *Railroad Gazette* says the plant supplies gas to all divisions of the Southern Railroad entering Chattanooga, and to sleeping cars on the Nashville, Chattanooga, and St. Louis Railroad. The gas receivers are charged with sufficient gas for a trip to Washington, 1344 miles, and return, and to New Orleans and return, 984 miles. In December, 1893, these works sold 53,827 cubic feet of gas; and in December last, 236,353 cubic feet—being a gain of more than 300 per cent.

The Origin of Petroleum is still a mystery, says Mr. G. T. Baker, in the *Cosmopolitan*. It seems really incredible that animal or vegetable oil should so accumulate as to furnish the output of Baku. It is also significant that the deposits follow a line of profound terrestrial disturbance—that of the Caucasus. It was to account for these oil-fields that Mendeléeff put forward his hypothesis. He supposes that there are vast masses of metallic iron within the earth, resembling meteoric iron and containing carbon. The action of acids on such iron produces hydrocarbons which are sometimes identical with those of Baku oil. If one accepts the supposition of the existence of iron in great quantities within the earth, this theory leads to fewer difficulties than that of organic origin; and since such iron has been brought to the surface of the earth at a number of points by eruption, the plausibility of the hypothesis is great.

The Transactions of the Society of Engineers.—We have received the volume of Transactions of the Society of Engineers for the past year, edited by the Secretary (Mr. G. A. Pryce Cuxson). It is a record of good work, performed under the presidency of Mr. G. A. Goodwin, as evidenced by the papers read during the session, and the visits paid in the vacation. Among the former is the important communication by Mr. E. Lloyd Pease on "Gasholder Construction," an abstract of which was given in the JOURNAL at the time it was submitted; and among the latter is a visit to the South Metropolitan Gas-Works on June 5. One of the papers is on "Pile Driving;" the author being Mr. H. O'Connor, Assoc.M.Inst.C.E., who, as stated in our columns last week, has lately left Beckton, and joined the firm of Messrs. J. Milne and Son, Limited. Both of these papers are illustrated by folding plates. The "Obituary" contains the names of several gentlemen connected with the gas industry. Mr. Alfred Williams, one of the founders of the Society, and its Honorary Secretary and Treasurer at the time of his death, stands first to be mentioned. A very well executed portrait of him is given as a frontispiece to the volume. Mr. G. Garnett, Mr. W. Syms, Mr. G. Eraut, and Mr. H. Faija are also among those who have been removed from the ranks of the members. The volume is bound in the usual style, and is furnished with a general index to the proceedings from 1857 to 1894. It is published by Messrs. E. & F. N. Spon.

Coal Contracts for Gas Manufacture.—The contracts for the coal supply of the great London Gas Companies are, says the *Engineer*, "among the most decisive as to the condition of the coal trade. These contracts are now being arranged for the period that commences with the month of July; and it is already evident there will be a considerable reduction in the rate that has been paid under the contracts that then expire. It is believed that the range of the prices to be paid for Durham coal will be equal to from 6s. 1½d. to 6s. 4½d. per ton, free on board; and this is a price that will be probably 6d. to 10½d. per ton below the contracts that are approaching expiration. Such a fall in price is now general for coals used for gas manufacture; so that there will be a considerable saving to the producers of gas generally from the change in the condition of the coal trade. Last year higher prices were asked; and as there had been prolonged strikes, that had made coal scarce, the sellers were able to exact better prices. But the production of coal rose so largely that, for the past year the total output of the kingdom was the greatest on record; and thus there is, with the recurrence of the coal-contracting period, the ability to buy at lower prices—at prices that are more like the average of recent years. It is interesting in this connection to notice the enlargement of the output, which, in round numbers, was, in 1875, about 131,842,000 tons for the United Kingdom; by 1885 it rose to 159,347,000 tons, or an advance of, roundly, upwards of 27,000,000 tons in that time; and now for the past year there is the record output of 188,277,000 tons, or even a larger increase in the nine years than there was in the previous decade. This is the more surprising when it is remembered that the strike in Scotland seriously affected the output of that country for several months in the past year. But the result of the increase was not only to fill up any void of previous capacity; it has also had the effect of causing coal to be so plentiful that all the contracts for the great consuming industries are being let at prices that are lower than for the past year. Thus the gas companies will reap the benefit from the lower prices. Spread over a consumption that in one or two cases rises to more than 1,000,000 tons yearly, the effect of the fall of from 6d. to 1s. per ton in the price is at once evident, and must have its effect in the future cheapening of gas."

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1097.)

THE change which came over the face of things on the Stock Exchange last week was about on a parallel with the change in the weather from brilliant sunshine to icy blasts. The feeling of apprehension that the mining boom had been allowed to go a little too far, to which we referred last week, culminated in a severe check, showing itself soon after the opening. The "squeezing out of weak bulls," howsoever wholesome and prudent a measure, was not unattended with inconvenience; and the tone in the speculative departments governed to a great extent even the most steady-going. Thus prices received a general set-back; and perhaps they wanted it. The prevailing tone is none the worse for the incident; and no permanent depression is likely to result. The Money Market is quiet and unchanged. In the Gas Market, business was well up to the average; and everything dealt in was buoyant and full of strength. Several quotations have made more or less considerable advances; and these range over undertakings in all parts of the world. In Gaslights, the "A" at once shaped for an upward course, and, opening at 270½, touched 274 several times in the week. The "H" went hand in hand with it; while more than one of the preference issues changed hands at figures in excess of the nominal quotations, but the latter are still left unchanged. All transactions in South Metropolitans were marked at prices which looked like rising; and the debenture stock did go up a point. Commercials again failed to furnish a single bargain. The Suburban and Provincial Companies, although not particularly active, have again been conspicuous by their steady progressive march. British has pushed up another step; and Bromley, which had been left sleeping for the best part of a twelvemonth, was roused by a transaction, and advanced. Among Continentals, fair business was done in European and Imperial. The latter made a substantial improvement; but Union was not dealt in. Among the rest, there was a further advance in Bombay (why these shares should be pushed up higher than those of some of the choice home companies is a mystery); and Buenos Ayres had a fractional rise. The course of the Water Companies was irregular. Four of them advanced, and two receded.

The daily operations were: The Gas Market opened on Monday with a healthy and vigorous tone, and excellent prices were the rule. Gaslight "A" and "H" improved 1 each; and British, ¼. In Water, New River had a further fall of 5; but East London recovered 2. Business in Gas was quieter on Tuesday; but prices remained buoyant. Gaslight "A" made another advance of 2; Imperial Continental, 2; each Bromley issue, ½; and Bombay old, ¼. Lambeth Water fell 1. Wednesday's transactions were somewhat restricted. But everything was very firm; and Imperial Continental improved 1 more. Buenos Ayres also rose ¼. There was more activity on Thursday, coupled with capital prices all round; but the only advance in quotation was a rise of 1 in South Metropolitan debentures. Several Water stocks were a little firmer; Chelsea, East London, and Kent advancing 1 each. On Friday, several Gaslight issues were active and very strong; but quotations did not move. General firmness characterized Gas on Saturday; and Imperial Continental advanced 1.

ELECTRIC LIGHTING MEMORANDA.

An Old Story Retold—The Trouble of the Fittings Trade—The Bad Work of Wiring Contractors.

IT is not surprising, though it is not without interest, to observe how in many respects the modern experiences of electric lighting undertakers repeat those of the early gas companies. One can afford to recall with a feeling of amusement the random claims of electricians and their newspaper supporters in the early days of the last decade to powers of doing business in artificial lighting upon altogether new principles—among the rest, that of avoiding all the sources of unpleasantness between the purveyors and the public, which were so familiar to gas manufacturers and consumers. When people took to electric lighting, as they were assured, there would be no disputed accounts arising out of eccentric meter registrations, no complaints of bad light, no troubles from leakage in streets or houses, and, in short, none of the grievances which too often rendered gas companies unpopular. Well, we have lived to see these sanguine expectations disappointed by the actual course of the electric lighting business. Electricity meters are dearer than gas-meters, and, to say the least, not more trustworthy. Electrical leakage is a source of considerable trouble to all highway authorities. The light provided by central station electricity-supply companies is not always above reproach; and the operations of the stations themselves furnish occasion for as many actions for nuisance as if these establishments were mere gas-works. One of the most interesting and important of the practical problems which the early gas companies had to dispose of as best they might, has moreover cropped up at Leicester, in connection with the municipal electric lighting undertaking just opened in this progressive town. We allude to the question of who is to do the interior fitting of houses taking the light.

From the commencement of the gas industry—and, indeed, down to the present day in some localities—there has been determined trade opposition to the supply and fixing of gas apparatus by the gas company, or their successors the municipal gas committee. The voice of the shopkeeper was loud in the land; and as the result, the gas company had nothing to do with indoor fittings in the greater number of British towns. What this meant to the consumers of gas is notorious. Of all the occupations of the "three-branch hand," the gas-fitting was the least understood and the most scamped; until in many places gas itself was nearly choked by the iniquities of the local gas-fitting fraternity. It is only of late years that the suppliers of gas have bestirred themselves in a general effort to shake off the incubus of the cheap plumber; and the mischief done by this plague in the past can never be wholly eradicated. Now, however, there are numerous towns where a satisfactory standard of gas-fitting is either maintained by a department of the gas company or the corporation gas committee, or is more or less efficiently prescribed and insisted upon by regulations to this effect. Leicester is one of the towns where the interior fitting of consumers' premises has always been undertaken by the gas authorities; and when the Corporation adventured upon an electric lighting department, it was but natural for the scheme to include the provision of wiring for such customers of the department as might prefer to leave the whole responsibility for their installation with the Corporation officers.

This resolve, of course, has aroused the ire of local firms of "electrical engineers," who have been raising in the Leicester newspapers an exceedingly bitter cry against the "undignified" action of the officials of the Corporation in "touting for installation work," and arguing in familiar fashion against the unfairness of Corporation competition with private firms, who are necessarily also ratepayers. A particular grievance urged against the Corporation is that the new department is making the profit upon the installation branch help to reduce the present loss upon the supply of current. But this is only what electric lighting undertakings have done all the world over; and sorry enough they are, as a rule, when the installation work is finished, and the generating station left to earn its own living. The Leicester Corporation are not likely to pay much heed to the clamours of a few interested shopkeepers, whose position in the industry is only that of would-be middlemen. There can be no reason why what the Corporation have done for years, to public advantage, for the gas consumers should not be extended to users of electricity for lighting. If the local "electrical engineers"—which is an elastic term, often meaning plumbers and house decorators who have added an odd "lineman" to their staff—cannot compete with a Corporation department, the failure is largely due to the lack of confidence in contractors for electric light wiring caused by the prevalence of bad work. Only last week the *Electrical Review* gave publicity to some shameful examples of scamped wiring; remarking at the same time that "pernicious work is widespread, and permeates all classes of wiring." The worst of it is, moreover, that the evil is not restricted to the performances of small contractors or cheap workers in this line, but is found in wiring carried out, presumably at a remunerative price, by certain "highly respectable West-End firms." Our contemporary declares upon this text that, while having little desire to take up an alarmist attitude, "a contemplation of the possibilities that may arise fills us with dismay." In one instance, the casing that contained the joint was charred black; "and it was certainl' not the fault of the wiring firm that there had been no fire.' The same journal goes on to describe the genesis of many a "wiring firm," who if they happen to get work, not only execute it in the worst possible manner, but threaten legal proceedings against any central station engineers who endeavour to protect the public against them. If we have discussed this subject at some length, starting from the case of Leicester, it is because the whole matter of electric light wiring is of the first importance to all parties concerned; and the revolt of fittings' contractors against central station authorities serves to illustrate, by repeating, one of the greatest of the troubles of the gas industry in its early days.

Southern District Association of Gas Engineers and Managers.—The spring excursion meeting of this Association will take place on Thursday next, when a visit will be paid to Southampton. According to the programme issued by the Honorary Secretary (Mr. J. W. Helps, of Croydon), the members and friends will leave Waterloo shortly after eleven o'clock; and on arriving at Southampton—where they will be met by the President, Mr. S.W. Durkin—they will be conveyed to the gas-works, where luncheon will be provided by the Directors of the Southampton Gas Company. Subsequently, the works will be inspected, and then an adjournment will be made to the New Dock works; where, by arrangement with Mr. John Dixon, the Marine Superintendent of the London and South-Western Railway Company, an opportunity will be afforded the members of seeing the important extensions now being carried out. Tea and coffee will be provided at the South-Western Hotel before the return journey, which will be made at half-past seven.

AN AMERICAN ON BRITISH MUNICIPAL GOVERNMENT.

Second Notice.

Our first notice of Mr. Albert Shaw's interesting work upon Municipal Government in Great Britain left off at the point where the author begins to discuss the apparent collectivism of the modern examples of this form of government. He admits that in so far as what looks like socialism is discernible in these governments, it is in reality nothing more than a sum total of "all those governmental activities which have been superimposed upon the negative, or strictly necessary functions." It is exceedingly difficult to say how many of these new activities are but the application to changed conditions of the venerable principles of individualism. Mr. Shaw rightly thinks that if this were understood, many a fruitless argument would be clarified, and many a groundless apprehension set at rest. We should at least be spared the folly of those socialistic publications which point to the transfer of gas undertakings to municipalities as a proof of the advance of socialistic principles—the fact being that by no class of proprietors of such undertakings are the fundamental points of property and profit-making, both directly opposed to the root-idea of socialism, more strenuously upheld than by municipalities.

It would be going out of our province to follow Mr. Shaw through his instructive observations upon the law and the practice of the British Municipal system; but no part of his work is likely to prove of more value to those of his compatriots who take an interest in local self-government than his remarks upon the apparent similarities and actual differences between British and American municipal constitutions. We come closely into contact with our author again when, after his introductory generalities, he presents in his fourth chapter "A Study of Glasgow," with the confession that "the methods and results of British Municipal Government may best be studied in the concrete." Judged by its size as a distinct and complete municipal organism, Glasgow is, as the author says, the "first among the communities of Great Britain;" for Greater London has no similar organization. Very naturally, Mr. Shaw writes most flatteringly of the municipal life of Glasgow; and it is almost to be regretted that he has refrained from going to Thackeray for a picture of what the city was like before the Corporation took it in hand. For it is impossible to understand in full measure what the Corporation have done for Glasgow, without a knowledge of how much there was to do. Among the extra services in the cause of public safety and decency which the peculiar character of Scottish town building throws upon the Glasgow authorities, is that of lighting the "common-stairs," which are stated to cost more in this respect than all the public street lighting. It is recognized, however, that this expenditure should really be classified as for police protection, since every lamp is as good as an additional constable.

It is interesting to note how the Glasgow Corporation gas undertaking strikes an American observer, and satisfactory to learn that Mr. Shaw is able to declare that in this case "twenty-five years of management by the authorities has given unmitigated satisfaction to all the citizens." Speaking of the measurement of the city gas, the author artlessly observes that "it is not the policy of the Corporation to charge its customers for more than they actually receive," to which he thinks it is due that there is "a considerable percentage of loss in delivery." We might contest his opinion that no private company could have reduced the price of gas as the Glasgow Corporation have done during the twenty-five years of their possession of the gas undertaking; but we freely admit that this has been possible in their case because they have not made "profits" for the temporary relief of the ratepayers. Upon this head, Mr. Shaw says: "In the rather gloomy winter climate of Glasgow, which necessitates a large use of artificial light, cheap gas in all the tenements, however humble, and in every passage-way, is an inestimable blessing; and the more than doubling of the *per capita* use, under the city's management of the works, means a vast increase in comfort and happiness that defies statistical expression. Great wisdom and humanity have been shown, therefore, in the policy of smaller earnings and a less rapid debt payment for the sake of a more rapid reduction of the charge to consumers, and a more rapid growth of the total consumption. These considerations of the general good which dominate the public control of such services as those of light and water, can have only small weight in the counsels of a private money-making corporation; and *herein lies perhaps the most fundamental reason for the municipal assumption of such functions.*" The italics are ours. We shall see how the critic speaks of other Municipalities where the same "fundamental reason" does not govern the dealings of the gas committee with their customers. For it is not a question here between municipalities and companies, but between municipalities and municipalities. And although he does not suspect the fact, the British system of legislation with regard to gas supply by statutory companies, by creating a co-partnership between the company and the consumers, has succeeded in improving upon the practical operation of those "considerations of the general good" to which Mr. Shaw attributes the liberal administration of the Glasgow gas undertaking.

Coming next to Manchester, the first thing to be noted by the critic, and deservedly, is "the symmetrical and virile character of its municipal institutions," which are the outcome of a "strong municipal consciousness." The Corporation are very much in the minds of the citizens. Mr. Shaw tells his readers all about the constitution and functions of the Manchester Corporation, with its hundred sub-committees; and he declares that the more carefully this system is studied, both in theory and practice, the more worthy of admiration it seems. With respect to the gas supply of the city, it is observed that this is probably the oldest of all municipal gas undertakings, having "never been in private hands." The business is described as having grown to enormous importance; but no comment is made upon the subsidy paid over in relief of the rates. Altogether, Mr. Shaw has very little to say concerning the lighting of Manchester; but he prefers to discuss other departments of the city's municipal activities.

As to Birmingham, our author remarks, by way of introduction, that "so similar in general scope are the municipal activities of Manchester and Birmingham, that with some omissions and suppressions it is quite conceivable that an account of the one corporation could be made to do service with readers outside of England for an account of the other." Feeling that this would nevertheless be an unworthy way of treating the "municipal Mecca in the Midlands," Mr. Shaw sets himself to give a detailed account of what Birmingham has done for itself since it obtained its Charter of Incorporation. He declines, however, to concede to Birmingham all the priority and pre-eminence in municipalism claimed for it; pointing out that both Glasgow and (in some respects) Manchester have been before and remain ahead of it. He even dares to say that it should be a sufficient honour to Birmingham to have "accomplished enough to give it place and rank with these two." The striking feature of the municipal progress of Birmingham, however, is that it has taken place during so short a time—within the working lifetime of one man. Mr. P. H. Muntz is the exemplar of this striking reference. The golden age of Birmingham municipal life dates from 1873, when Mr. Joseph Chamberlain was elected Mayor, and at once proceeded to tackle the questions of the local gas and water supply. "Circumstances made it the better diplomacy to begin with the gas-works. Two competing Companies were supplying the citizens of Birmingham and lighting the streets. Mr. Chamberlain undertook private negotiations, and found that it would be impossible to induce these Companies to sell out their works and business on terms that seemed to him reasonable. He then presented the subject to the Council; making an elaborate argument in favour of his proposed policy, particularly from the financial point of view. He pointed out the growing needs of municipal revenue for objects not directly remunerative; and he held that the municipal management of the gas supply would yield large net profits with which sanitary and educational expenses could be met. He expressed confidence in the business ability of the Council, and enumerated reasons why the Municipality could manufacture and sell gas more economically than the private Companies. No phase of the subject was neglected in Mr. Chamberlain's comprehensive presentation. The Council was so completely convinced, that a resolution favouring the purchase was adopted by a vote of fifty-four to two." We quote this passage in full for the sake of the picture it gives of the effect of personal initiative in matters of this kind. Mr. Shaw is content to bear witness to the profitableness of the bargain made under these auspices. His testimony to the other benefits that have accrued to Birmingham from and since the great impetus in its city life known as the "Chamberlain era," are well worth reading.

Without going into details relating to other towns, Mr. Shaw proceeds to discuss several salient points of mnnicipal activity generally—gas supply among the rest. He acknowledges that the arguments for the public control of gas undertakings are "certainly not so strong as those that can be urged in the case of water." The gas business is a more strictly commercial affair; and its conduct does not involve any of those far-reaching questions respecting the source and nature of the supply which in most cases render it expedient for towns to manage their own water. "But if a city wants excuses for assuming the manufacture and sale of gas, they are numerous enough." Many such pleas are offered for selection. But, as Mr. Shaw confesses in the end, it was revenue considerations that mainly determined the action of British towns in this regard. He does not know that Scotch corporations cannot make a profit out of gas supply; but he is fully impressed with the wide popularity of gas in Scotland. Oddly enough, he has missed the point that the introduction of the automatic prepayment meters owes nothing to municipal initiative, although he puts "the boon of cheap gas to the poor in tenement houses" among the benefits of the municipalization of the supply.

It is unnecessary to discuss London affairs with Mr. Shaw; suffice it to say that his views of pressing questions of Metropolitan administration are on the whole fair, with a leaning towards Progressivism. He falls, however, into the usual Progressivist blunder about the saving that could be realized by municipalizing the gas supply, which is due to the assumption that, upon the transfer of the undertakings, all the money now paid as dividends would be available for distribution in various popular ways. He really should have known better. Altogether, Mr. Shaw's little book reflects as much credit upon its author as for his part the author bestows on British municipal ideals and realities.

WATER COMPANIES' RESPONSIBILITIES FOR NON-SUPPLY IN FROSTY WEATHER.

No doubt full and fair consideration will be accorded by the Directors of the Lambeth and the Grand Junction Water Companies to the request made by some of their customers for a proportionate abatement of the rates which cover the period of hard frost, and consequent non-supply that occurred during the recent winter. But it is scarcely likely that the Directors, whatever course they may decide to take, will be greatly influenced by the covert, or even open threat of Counsel's opinion and the terrors of legal action, if a pacific settlement of the question is not conceded. It is more than likely that the Companies have already been well advised in regard to their legal position in the circumstances; and there is no reason why any body of dissatisfied consumers also should not seek legal counsel and advice, though the spectacle of a number of the Local Authorities combining merely to get an opinion which ought to be obtainable for a few guineas, is somewhat calculated to provoke a smile. We should be sorry to speak disrespectfully of the gentlemen "learned in the law;" but, really, it is impossible to forget how variously an opinion may be framed, and how much depends on the shape in which the case for the opinion is drawn by the solicitor. In regard to the great frost question, anything that may be called an opinion will probably take an extremely cautious and qualified form. There must necessarily be a great many "ifs" in such an opinion as this. "Probably" is likely to figure with some prominence; and it is conceivable that "on the whole" will be a phrase to be pretty frequently employed. No one, lawyer or layman, can predict, with absolute conviction and certainty, the view which a Court of Law will take on this—or perhaps on any other—subject. But we do know that the Judges are bound by precedent and authority; and for the purposes under discussion, precedent and authority afford small encouragement to the malcontents.

In the JOURNAL for the 2nd ult., we published an article entitled "The Legal Aspect of the Frost Question," in which the effect of certain relevant decisions was set forth; and the cases there noted may well engage the attention of those who now contemplate a legal campaign against the Companies. Everyone knows that the frost of last winter was one of quite exceptional severity; and it has been distinctly held (*Blyth v. Birmingham Water-Works Company*) that no liability arose where damage was caused through a frost of a character rarely experienced in England, the effects of which no company could by any possibility foresee or guard against. Water companies, like individuals, are required to take reasonable care. They must provide against injurious results from ordinary frost; and it may be that in some particular case that might be left to a jury a mixed selection of good men and true would discover some evidence of negligence. But, then, if they discovered what, in the eyes of the law, did not really exist, their verdict would be subject to correction at the hands of a superior tribunal.

The Water Companies—as we have previously had an opportunity of pointing out—are not, and cannot be made, insurers against the consequences of frost, any more than they can be made insurers against the results of fire. The legal accuracy of this position has been recognized even by that redoubtable champion of the water consumer, Mr. Archibald Dobbs. If Mr. Dobbs will not come to the rescue of the aggrieved consumers, what support can be expected from the less zealous student of water-works law, in the light of an instrument for chastising the Companies for their imaginary misdeeds? At one time, it seemed to be thought that Mr. Shaw Lefevre was going to enlist the formidable aid of the Law Officers of the Crown in connection with the suggested responsibility of the Companies in this matter of the frost. We hear no more of the Law Officers; but, of course, it is quite possible that lesser lawyers may afford to the malcontents some adequate encouragement to further test the law on the subject, if such encouragement is fully sought and paid for.

Water Consumption in New York.—The average daily water consumption in New York City last year was 183,000,000 gallons, of which 36,712,800 gallons passed through meters. Assuming the population of New York to be 1,950,000, the average consumption was 94 gallons per head per day.

Preventing the Pollution of Rivers.—A Bill has been introduced into Parliament to deal with the subject of river pollution. Its principal object is to improve the existing law, by extending to County Councils, Joint Committees, and Rivers Boards in England the main provisions of the Mersey and Irwell Act of 1892 and the West Riding of Yorkshire Rivers Act of 1894. New clauses are added for the following purposes: To prevent the pollution of streams by canals; to qualify Justices to act, though they are members of the local authority or ratepayers; to empower any local authority to contribute to the expenses of a prosecution by any other authority; to authorize the Local Government Board to order, in certain cases, the rating of areas specially benefited; and to enable a defendant to be a witness in certain cases. The Bill now stands for second reading; but it has been blocked by Mr. Broadhurst, Mr. S. Hoare, Mr. Colman, and Sir T. Roe.

NOTES.

A Painting Machine.

Messrs. A. C. Wells and Co. have been working in conjunction with Messrs. Henry Wallwork and Co., of Manchester, in the endeavour to produce a satisfactory painting machine; and they now claim to have perfected various appliances for spraying paint by means of compressed air, in which the many practical difficulties hitherto encountered in the spraying of heavy paints, tar, &c., are overcome. The apparatus is stated to work with small power. According to a description of the machine recently given in the *Engineer*, the paint or tar is atomized and sprayed on to the work by a stream of compressed air, which may be either taken from a main supplying power transmission by this means, or be generated on the spot by hand or power in a simple form of air-pump made for the purpose. The paint is contained in a pot, provided with a mechanical stirrer; and the pots may be readily changed when desired. The painting-nozzle is practically an injector of special form; and the determination of the best style has been a subject of prolonged experiment. The flow of paint at the nozzle is controlled by a small plug-valve and spring lever, on which the operator keeps his thumb while working, and which on release closes automatically. Much difficulty has always been experienced from the liability of small-way valves of this class to get choked by particles of skin or paint sediment. This is overcome in the machine by an arrangement whereby a further movement of the spring lever reverses the action of the nozzle, and permits of the obstruction being blown out by the air pressure. The machines are made in different sizes, capable of covering from 3 square yards per minute. In a cited experiment, a plate girder 70 ft. by 6 ft. by 2 ft., with gussets, vertical stays, &c., was coated with boiled oil by one nozzle in two hours, or more than equal to a full day's work for a man with a brush. The apparatus ought to be useful for painting gasholders in a hurry.

Dr. Joly on the Calorie.

Dr. J. Joly writes to *Nature* with reference to a recent communication of Mr. Griffiths to the Royal Society, calling attention to the indefiniteness attending our present knowledge of the heat unit, in order to suggest that some unit of heat other than the present calorie is desirable. He declares that the present thermal unit is highly arbitrary, as well as most difficult of verification. This is true, whether the temperature at which the calorie is to be measured as 4° C., or 15° C., or as the temperature of the minimum specific heat of water. Dr. Joly says of the calorie that it owes its perpetuation to the method of mixtures—a laborious and inaccurate system of calorimetry—and dates from a period when variations in the specific heat of water were not held of account. If the water calorie is to be adhered to, it will be necessary to proceed to verify it, as was done with the standard metre. Dr. Joly suggests instead, that we should start with an accessible unit; and he proposes the latent heat of steam at the standard pressure as having the first claim. One gramme of saturated steam at 760 mm., might be assumed to give up the unit quantity of heat in becoming water, without change of temperature. It is further suggested that this unit might be called a "therm," in order to avoid confusion with the existing unit. The specific heat of water would then stand as about 1·8 millitherms. The larger value of the new unit commends itself as being more applicable to the problems of applied science. Dr. Joly is aware that the alteration proposed is a radical one; but he holds that an appreciable change is better than a vexatious correction. Mr. Griffiths supports Dr. Joly's proposal, but without committing himself to go the full length. He prefers a centimetre-gramme-second unit. Dr. Oliver J. Lodge also suggests that it would be well to adopt the "Joule" as the only fundamental unit of heat.

The Discharge of Electrification by Light.

A recent number of the *Comptes Rendus* contains a paper by M. Branly, on the rate of loss of an electric charge due to the effect of light, in the case of badly-conducting bodies. When the source of the light is a body at a dull red heat, it appears to be the condition of the illuminating surface which has most to do with the resultant phenomenon. The nature of the charged body seems to make no difference. When the illumination is rich in highly refrangible rays, however, the case is quite different. Among the chief results obtained, are the following: If a disc of wood or of marble, polished or unpolished, is electrified, and then exposed to light, it immediately shows a marked loss of electricity. Negative electricity is lost quicker than positive electricity; but the difference is very much less marked than is the case with metal discs, particularly when they are polished. Similar results are obtained with cardboard, terra-cotta, and glass heated to 100° C. In the case of varnished wood, or wood coated with a thin layer of oil, paraffin, or tallow, the loss of a positive charge is rapid; while a negative one is discharged slowly under the influence of a light. A metal plate covered with grease only loses a negative charge very slowly; while the rate of loss of a positive charge is rapid. There is no record of the degree to which these changes are affected by differences of illuminating power in the operating light; but the subject lends itself to further experiment in this direction.

COMMUNICATED ARTICLE.

DETECTION AND MEASUREMENT OF COAL GAS IN AIR BY MEANS OF THE HYDROGEN FLAME.

By Frank Clowes, D.Sc. (Lond.), F.I.C.

The Redwood modification of the Clowes hydrogen-flame test has been adopted by many gas-works managers, and has been in use for some time. Judging from the letters received from many of those who are using the apparatus, the indications furnished by it are of a most satisfactory character. It will now be generally known that the presence of coal gas in the air is indicated by the appearance of a pale flame or "cap" surmounting the hydrogen test-flame. Arrangements are made in the apparatus for the hydrogen flame always to be burnt at a known standard height; and under these circumstances the height of the cap varies with the percentage of coal gas present in the air to an extent precisely known. The measurement of the height of the cap which is seen over the standard hydrogen flame becomes, therefore, a direct indication of the percentage of coal gas present in the air.

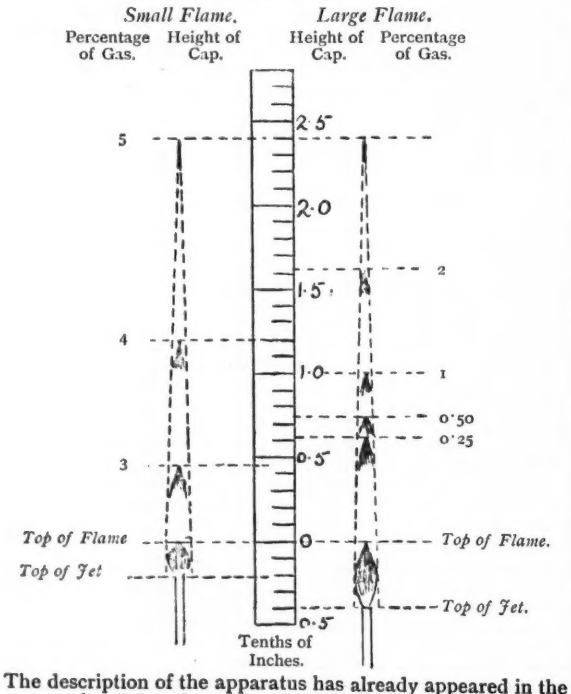
It has been found advantageous to employ the hydrogen flame adjusted to two different standard heights. The larger flame is 0·4 inch in height, and is used for measuring percentages of gas varying between 0·25 and 3; while the smaller flame is 0·2 inch heigh, and is used for measuring percentages of gas from 3 to 5. Since the presence of 5 per cent. of coal gas in air produces a mixture which is explosive when kindled from below, there appears to be no object in carrying the graduated indications higher than this; but readings may be easily extended downwards to 0·1 per cent. of gas, or above 5 per cent. if desired.

The measurements given below have been taken with the greatest care and precision over the standard hydrogen flames placed in artificially prepared mixtures of gas and air; and they may be absolutely relied upon. The cap-heights, with their corresponding percentages of gas, are as follows:—

Percentage of Coal Gas in Air.	Corresponding Height of Cap in Inches.	
	With Large Hydrogen Flame.	With Small Hydrogen Flame.
0·25	0·63	..
0·50	0·74	..
1·00	1·00	..
2·00	1·62	..
3·00	2·40	0·46
4·00	..	1·20
5·00	..	2·40

The indications in the table have been thrown into the form of a diagram, which can be carried in the pocket, and gives at once the percentage of gas present after the cap-height has been read upon the scale of the instrument. The diagram on the pocket scale-card is shown on the accompanying illustration.

STANDARD HYDROGEN FLAMES AND CAPS, WITH PERCENTAGES OF COAL GAS.



The description of the apparatus has already appeared in the JOURNAL; but it has been thought well to append the present statement in the interest of gas-works managers generally. The suggestion of the necessity of furnishing this further information has arisen from numerous inquiries having been made regarding the trustworthiness of the indications furnished by the apparatus. The results are quite accurate, provided the apparatus is used as is directed.

The indicator card referred to above can be obtained from the makers of the apparatus, Messrs. W. J. Fraser and Co., of Commercial Road East, who are also prepared to show the apparatus in use, and to fully explain the method of applying it to the detection and measurement of small proportions of coal gas in the air.

TECHNICAL RECORD.

EASTERN COUNTIES GAS MANAGERS' ASSOCIATION.

The Thirteenth Half-Yearly Meeting of this Association was held last Wednesday, at Sudbury (Suffolk), the gas-works of which town are leased by the Gas Company to Mr. C. W. Grimwood, the President for the year. The members assembled shortly after noon at the Town Hall, the use of which had been kindly granted to them by the Mayor (Mr. R. Mattingly). Before proceeding to business, the visitors sat down to a cold collation, which had been generously provided by the Directors of the Gas Company. Mr. G. H. Grimwood (one of the Directors) presided—supported by the Chairman of the Company (Mr. B. Simpson), the Mayor, and other local gentlemen.

At the commencement of the business, the retiring President, Mr. W. J. CARPENTER (Great Yarmouth) occupied the chair.

The HON. SECRETARY and TREASURER (Mr. Harry Wimhurst, of Sleaford) first read the minutes of the previous meeting, which were confirmed.

AN OFFICIAL WELCOME.

The MAYOR here addressed a few words of welcome to the members; and, in doing so, he referred to the ancientness of the borough of Sudbury—claiming for it an ancestry of some 700 years.

The CHAIRMAN appropriately responded on behalf of the members.

NEW MEMBERS.

On the motion of the HON. SECRETARY, seconded by Mr. C. WRIGHT (Saffron Walden), the following gentlemen were elected members of the Association: Mr. C. Banham, of Wymondham; Mr. A. L. Clarke, of Maldon; Mr. J. Witten, of Southtown; and Mr. F. R. Child, of Halstead.

REPORT AND ACCOUNTS.

The annual report and the statement of accounts (which had been circulated among the members) were taken as read, on the motion of Mr. J. CARTER (Lincoln), seconded by Mr. C. G GRIMWOOD. The report was as follows:—

The Committee in presenting the sixth annual report to the members of the Association, express satisfaction at the progress made during the year.

The spring meeting was held at Bury St. Edmunds under most favourable circumstances. The gas-works were open for inspection to the members; and the Engineer (Mr. Alex. Mitchell) kindly provided light refreshments for the members—his kindness being much appreciated. The President (Mr. W. J. Carpenter, Assoc.M.Inst.C.E.) delivered a most interesting Inaugural Address; and discussions took place upon "Differential Prices for Gas," and "Are Meter-Rents Desirable?"—many members taking part in the very interesting debates. The members and friends after the meeting visited the famous Abbey ruins and Botanical Gardens; and later in the day they dined together at the Suffolk Hotel. The following morning many members and friends drove to Ickworth Park—the seat of the Marquis of Bristol—at the invitation of G. H. W. Hervey, Esq., who entertained them to luncheon, which was much appreciated.

The autumn meeting of the Association was held at Great Yarmouth under the presidency of Mr. W. J. Carpenter, the President. The Directors of the Yarmouth Gas Company most handsomely provided luncheon for the members before the meeting. Two papers were read—the first by Mr. W. D. Child, upon "Retort-House Construction." This, with the discussion thereon, is a valuable acquisition to the transactions of the Association and the profession generally. The second paper was by the Hon. Secretary and Treasurer. It narrated his experience with the prepayment meter system, and evoked a fair discussion. The members and friends dined together during the evening.

The officers for the year 1895 were elected at this meeting, as follows: President, Mr. C. W. Grimwood; Vice-President, Mr. A. Drage; Hon. Secretary and Treasurer, Mr. H. Wimhurst; Auditors, Messrs. C. Ellis and C. Panchen; Committee, Messrs. J. T. Jolliffe and W. D. Child.

The accounts for the year show that a balance was brought forward of £21 18s. 6d. Subscriptions were received to the amount of £34 2s. 6d.; making a total of £56 1s. The expenditure during the same period has been £31 15s. 6d.; leaving a balance in hand of £24 5s. 6d., with a few subscriptions outstanding.

The year began with a membership of 60. Eight additional members were elected during the year; two members have severed their connection with the Association under Rule 17; and the Committee have to record the death of three members: Mr. G. Eraut, of Braintree, Mr. G. Garnett, of Ryde, and Mr. F. Weller, of Southtown, who

was one of the Auditors of the Association from its inception, and who took a keen interest and was a prominent member at all meetings of the Association. One member resigned during the year; leaving a membership of 62 on the 1st of January.

Your Committee request that each member will use his influence and assistance in promoting the best interest of the Association.

A Vote of Condolence.

The Hon. Secretary moved—"That the sympathy of the members of the Eastern Counties Gas Managers' Association and of this meeting be accorded to Mrs. Weller in the great loss she has sustained by the death of her late husband, Mr. F. Weller, who was from its inception one of the Auditors of the Association."

The President-Elect (Mr. C. W. Grimwood) seconded the motion. He remarked that the members all knew something of the character of their late friend; how he was held in high esteem by everyone. His large-heartedness, generous nature, and kind disposition were well known to the members. It was his (Mr. Grimwood's) painful duty to attend the funeral at Gorleston; and he saw how highly Mr. Weller was appreciated there. Their late friend had been connected with the Association from its commencement; and he was one of the very few who assisted in starting it. He thought it was appropriate that the Association should send this expression of their deep sympathy with his widow.

The resolution was carried by the members silently rising.

Thanks to the Ex-President.

Mr. Carpenter having vacated the chair,

Mr. Grimwood said his first duty was to propose a vote of thanks to Mr. Carpenter, who had so ably presided over the Association during the past twelve months. They would all remember his year of office, and the great interest he had thrown into the work of the Association.

The proposition was passed by acclamation.

Mr. Carpenter having suitably acknowledged the vote,

Mr. Grimwood observed that the meeting was being held somewhat later than was customary, owing to the illness of the Secretary, who had been suffering from influenza and a complication of complaints. He (the President) had also been suffering from a very painful and distressing complaint; and under the circumstances, he need not ask the members to excuse the delay. He then proceeded to read the following

INAUGURAL ADDRESS.

When some time since, I began to select the subjects on which I proposed to offer a few observations on the present occasion, two matters presented themselves to my mind as of necessity taking precedence of the rest. The first was that I should take this opportunity of expressing to you my most cordial thanks for having placed me in the honourable position of President of this important Association. These thanks I now have the pleasure of tendering; and, with the expression of them, I venture to ask those friends whose good wishes have given me my present office to kindly extend their favours, and not only to give me their assistance in regard to my responsibilities, but also to grant me their indulgence in my shortcomings. The second matter is of equal importance, to my mind. It is for me, as your President, to give you a hearty greeting on your visit to this ancient town of Sudbury. To welcome this representative body of gas engineers on the occasion of the thirteenth general meeting of our Association, is for me a great pleasure and honour; and I trust that you will all, at the conclusion of these proceedings, carry away with you pleasant memories of the old town of which I am proud to be a native. Having now discharged these two pleasant obligations, I will ask your indulgence while I set before you, as well as I am able, some few of the thoughts which occupied my mind while selecting the material for this short address.

First of all, a few words as to the welfare of our Association. You have all received from our worthy Hon. Secretary a copy of the report for the past year, from which you will see that we have not gone backward, although the progress made has not been as marked as we should have liked. In this connection, I am inclined to think that something might be done towards increasing its membership roll, if we all put our shoulders to the wheel. Let each of us, therefore, take to heart the concluding paragraph of the report, and use his best efforts and influence in inducing suitable men to join us. East Anglia is a wide area; and there is plenty of room for all our efforts.

In taking a retrospective view of the winter through which we have recently passed, there are possibly few in this room who can look back with equanimity and pleasure at the additional work thrown upon them during our late Arctic experiences. A gas manager's responsibilities are at no time particularly light; but during such long-continued and severe frosts as we have had this year, they become onerous and trying in the extreme. Frozen gasholder tanks, frozen mains and service-pipes, with difficulty in obtaining a supply of coal, water, and other necessities, keep him constantly on the rack; and happy is he who, when the bad time is over, can congratulate himself upon having passed safely through the ordeal. Here in Sudbury, as in other places, the cold was intense, registering, night after night, some degrees below zero. Out of a total of 175 lamps in our streets, as many as 60 were on some nights frozen, and could not be lit. Ordinary consumers, fortunately, were but little inconvenienced, as only four or five complaints were received during the whole of the severe time; and these were quickly remedied. With respect to the gasholder here (I have only one in use), I had little or no trouble, although the tank is mainly above ground. There is a small hot-water apparatus connected with the tank; and by keeping this in continuous operation, the freezing of the water was effectually prevented. Luckily I had no difficulty with frozen scrubber, purifier cups, &c.; and as to the coal supply, I had a good store by me. Although my usual deliveries did not on some occasions come up at the proper time, I am happy to say I was not inconvenienced on that account.

Although the experiences through which we have passed are so unusual that they may possibly never occur again with many of us, it is well, I think, to chronicle in some way the difficulties the great frost of 1895 brought about, and the means we took to surmount them; and I venture to throw out the suggestion to those members who are in search of subject-matter for a paper for a future meeting, that here might be found ample scope for an interesting one. Personally, I should be very pleased to supply any particulars in my power, and have no doubt many others would do the same. Such a record might afford many valuable hints for future guidance, both in respect to the precautions to be taken to guard against frost, and in respect to remedial measures when the severe cold has brought about a stoppage of the gas supply or other disasters. Very recently we have seen that a paper has been read before the North of England Gas Managers' Association by Mr. W. Hardie, jun., describing the difficulties brought about by the frost in his district. The paper is a most interesting one; and I hope some of our members will compile a similar record for this part of Great Britain.

The difficulties entailed by the cold "snap" recall to my mind those brought about by the great coal strike two years back; and the fact that at the present time I am using at the works here some of the coal I obtained during that period, adds force to my recollection. I am sure that we must all hope that such strikes will soon be a thing of the past, and that conciliation and arbitration boards will prevent in the future such dislocation of trade as is entailed by a widespread labour dispute of this nature. A strike may well be likened, I think, to a stone thrown into a quiet pond; for just as the stone ruffles the surface of the water, and causes ever-widening circles of disturbance, whose effects last long after the stone has disappeared, so does a strike affect the great sea of British industry—extending in its effects far beyond the district immediately concerned, and bringing about results which are felt for years after the dispute has terminated. In the case of a coal strike, this seems particularly true, for all the staple industries in our land are more or less dependent upon our coal supply; and when a strike is allowed to check and paralyze that supply, its injurious effects extend far beyond the limits of the coal trade. All industries, more or less, suffer; and the injuries sustained in many cases are irremediable and permanent. There are, I feel sure, few here present who will not agree with me when I say that in labour disputes every practicable means ought to be tried before recourse is had to that most suicidal "remedy"—a strike.

There is one matter connected with our coal supply to which I would like here to refer. I would throw out a hint to our colliery proprietors and coal factors that, now that the 21 cwt. per ton system has been abolished, care should be taken that the full 20 cwt. per ton reach the destination intended. A leakage, which is in itself apparently trivial, if continuous, assumes important proportions.

Another matter I should like to touch upon is the question of meter-rents. I was very pleased to see the announcement some months ago that the largest Gas Company in the world had decided to discontinue, at a sacrifice of many thousands of pounds annually, what I have always considered an unpopular charge; and I am also glad to see that other large companies are following suit. In my opinion, meter-rents, as such, will soon be a thing of the past; and the rapid introduction of the prepayment meter will no doubt help to bring about such a result.

Now that so many of our gas-works use oil for enrichment and gas-producing purposes, the late rise in the price of that commodity must naturally give occasion for reflection. The introduction of oil into gas-works has, of course, been largely influenced by the favourable figures obtained from calculations based on the low price of it; and there can be no doubt that any sharp fluctuation in the oil market, such as has been lately experienced, must tend to cause anxiety in the minds of those who are using this material, in a large way, on their works. Those of us who confine our attention to coal and cannel may, however, have easier minds; for at present there seems no reason for anticipating anything unfavourable in the matter of prices or source of supply.

Indeed, it seems to me that we gas engineers may well congratulate ourselves upon the present commercial aspect of our industry. A glance at the stock and share lists, which appear weekly in our trade journals, will show that, as an investment, some of the largest gas undertakings would be hard to beat. In many of the first-class gas stocks, the price of £100 shares is over £200, and in one or two cases above £300; and, at existing

prices, it is almost impossible to buy good ordinary British gas stock to pay 5 per cent. dividend.

When we consider that the whole industry has arisen during the present century, one hardly knows what most to be surprised at—the astonishing development of the industry, or how people got on without gas before. From the rough torch made of twigs or strips of bark smeared with pitch or fat, mankind progressed to the rough oil-lamp and to the wax candle. The era of the lamp and candle lasted until the beginning of the present century; and then gas came on the scene. Sixty or seventy years later, electricity appeared on the scene; and now at the present time, all these four methods of illumination are existing side by side—each developing in its own way, and each finding out for itself the lines of usefulness most adapted to its capabilities and merits.

Perhaps before long another illuminant may appear on the scene, although in what direction it is to be looked for it would be rash to conjecture. Scientists are ever at work; and the most astute of them would hardly like to hazard a guess as to what may be hit upon. We have most of us, I daresay, been interested lately in reading about acetylene—that wonderful gas which Professor Vivian B. Lewes showed to so interested an audience some short time since at the Society of Arts. When we read that a gas of 240-candle power can be obtained from a combination of chalk and carbon, called calcic carbide, by the addition of water merely, one is tempted to think that to the four popular illuminants mentioned a fifth may possibly be added before the close of the century.

With respect to incandescent gas lighting, about which we have heard so much during the last year or two, the success achieved by the Welsbach light is stimulating the ingenuity of inventors to a marked degree. One of the latest outcomes (of which perhaps more will be heard) is a French notion, with which the name of the inventor—M. de Mare—has been associated. It may be described as a small burner on the atmospheric or Bunsen principle, capable of being attached to the ordinary gas pendant or bracket, and requiring no chimney or globe. The size of the burner is practically that of an ordinary batswing, and directly over the flame is stretched a platinum wire, to which is attached a fringe of cotton, which has been previously steeped in a mineral solution and dried. These hanging fibres are brought to an incandescent state by the flame; and a steady white light is the result. How the light will answer when subjected to the ordinary practical and commercial tests, is a question which only the future can decide.

In conclusion, I would say that, in my opinion, our old friend, coal gas, will last our time, and hold its own. We are daily improving its manufacture, and developing fresh methods of use, and fresh lines of utility. Gas is the light of the people, and will, I believe, continue to be so.

Gentlemen, I will now bring my few remarks to a close. They have, I fear, been somewhat disjointed; but that is all the more reason I should thank you, as I now do, very heartily for the friendly attention you have so kindly given to them.

Mr. CARTER moved a vote of thanks to the President for his interesting address. He said those who had experienced the difficulty of preparing an inaugural address would very readily be able to appreciate the President's efforts; for it was not at all an easy matter to put anything in an address of this sort that could be said to be in any way original. The address to which they had listened was eminently characteristic of the man who had prepared and delivered it.

Mr. CARPENTER seconded the motion, which was heartily agreed to.

The PRESIDENT acknowledged the vote, and said he should like to mention that, when writing the address, the boom in petroleum was at its height; and, having now collapsed, it had somewhat "taken the wind out of his sails." With reference to the De Mare incandescent gas-light, he had been in London since he prepared the address, and had called at the office of the De Mare Incandescent Gas-Light Company. He saw Mr. Sheldrake, one of the Directors of the Company, who explained the light to him very fully. Unfortunately, he had no apparatus there for testing the consumption of gas, nor a photometer for testing the illuminating power. He (the President) was informed that the consumption of gas was 2¾ cubic feet per hour, and also that the illuminating power was 25 candles. But he should not like to accept these figures, unless he saw the light tested. There was another point about the De Mare light. He gathered from the JOURNAL OF GAS LIGHTING that morning that there was a lawsuit pending; and he should like to say that he was of opinion (he was afraid almost to say anything about these incandescent lamps) that it was not a light that would be seen very much in this country. It might do very well for France; but it would not do for England.

PAPER ON GAS-WORKS CONSTRUCTION.

Mr. A. DRAGE (East Dereham) then read a paper on "Gas-Works Construction," which, with a report of the discussion which followed, will be published in an early number.

THE AUTUMN MEETING.

Some conversation followed as to the place at which the autumn meeting should be held; and it was eventually agreed, on the motion of Mr. J. T. JOLLIFFE (Ipswich), seconded by Mr. DRAGE, that Wisbech should be visited.

VOTES OF THANKS.

Mr. JOLLIFFE said the members were much indebted to the Mayor for the use of the Town Hall and for his presence at the meeting; and he had much pleasure in proposing that a hearty vote of thanks be accorded to his Worship for his kindness.

The proposition was carried by acclamation.

The MAYOR, in reply, remarked that the vote was quite unnecessary; but nevertheless he highly appreciated it, and the spirit in which it had been passed. He assured the members that, at no period of his official life, had it given him more pleasure to place the Town Hall at the disposal of any body than it had done on this occasion. He had listened to their proceedings with considerable interest; and he felt, as a consumer of gas, that, if the discussion had been mainly directed to the interests of the managers and shareholders of gas companies, the interests of the consumer had been looming in the background, and had not been altogether lost sight of.

Mr. A. MITCHELL (Bury St. Edmunds) moved a vote of thanks to the Directors of the Gas Company for having kindly entertained the members to luncheon.

Mr. JOLLIFFE seconded the motion, which was heartily agreed to.

The PRESIDENT promised to convey to the Directors this expression of thanks.

Mr. CARPENTER (Great Yarmouth) proposed a vote of thanks to the Hon. Secretary.

Mr. J. DIXON (North Walsham) seconded the proposition, which was cordially passed.

Mr. WIMHURST remarked that he was much obliged to the members for this acknowledgment of his services. Anything he could do for the Association was always a "labour of love;" but he was afraid that, at the end of this year, he must ask to be relieved of his duties.

This concluded the business of the meeting.

After a short interval, the members, with a number of local and professional friends, dined together at the Rose and Crown Hotel. The following day, a few of the members had an excursion to the neighbouring town of Long Melford. They first visited the Hall, where they were courteously received and conducted over the mansion by Sir William and Lady Hyde Parker. After partaking of refreshments, they wended their way to Kentwell Hall, the country seat of the Bence family. An inspection of the church followed; and the party wound up an enjoyable outing by visiting Mr. C. J. N. Row, the Secretary of the Long Melford Gas and Coal Company.

Gas Profits at Heywood.—The profit of the Heywood Corporation Gas Department for the past year amounts to £812. If the price of gas had not been reduced by 2d. per 1000 cubic feet, the profit would have reached £1600.

A New Water Reservoir for Pontypridd.—Messrs. Aird and Sons have commenced the construction of a new reservoir for the Pontypridd Water Company. When completed, it will have a capacity of 200 million gallons, and will cost from £50,000 to £60,000.

Additional Storage at the Bridgnorth Gas-Works.—The steady and continuous increase in the consumption of gas at Bridgnorth during the last few years has rendered the consideration of the provision of more storage accommodation an absolute necessity. The Consulting Engineer of the Corporation Gas Committee has called their attention to the subject, and has pointed out that the holder capacity at present available is not more than 60 per cent. of the largest output, although it ought to equal 125 per cent. It also prevents the working of the retorts to the best advantage, and leaves the management at the mercy of any untoward incident that might occur in winter. He recommends that the present holder, with a capacity of 50,000 cubic feet, should be superseded by a two-lift holder of 115,000 cubic feet capacity on the Gadd and Mason principle, in a steel-lined tank; and he points out that, if the risk of a partial failure in the supply next winter is to be avoided, there must be no time lost in placing the contract, which he estimates will absorb a sum of about £18,000. At the last meeting of the Council, the Committee were authorized to undertake the work immediately, for the execution of which they have already invited tenders through the JOURNAL.

Austrian Incandescent Share Company, Limited.—The first ordinary general (statutory) meeting of this Company was held last Thursday, at the Cannon Street Hotel. The Chairman (Major-General Beresford) said that this being the first meeting of the Company, he had really very little to say, except that the issue of shares was a very great success—far greater than the Directors anticipated. The accounts of the Vienna Company would not be closed until June 30; and then they would know what dividend would be declared. On the dividend that the Company paid, their own would depend. The Directors learnt that it was probable the profits would be even larger than was anticipated when the shares were issued. The shares they bought at 5000 gulden could not be purchased now at 7000 gulden, which showed the progress they had made. The Vienna Company had effected advantageous arrangements for working the incandescent gas-light on a large scale in countries where hitherto it was little known. This would result in a larger profit to the mother Company, and, as a result, to this Company. No questions being asked, this closed the proceedings of the ordinary meeting. An extraordinary meeting was then held, at which it was resolved to make certain alterations in the Articles of Association, in order to comply with the requirements of the Stock Exchange Committee, so that the Company might obtain a quotation.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by correspondents.]

Mr. G. E. Stevenson's Gas-Engine Paper.

SIR,—Messrs. Tangyes Limited have asked me to correct an error in my paper on "The Modern Gas-Engine," in reference to the fuel used for working their large gas-engine. It is not "Dowson" gas which is used, but "producer" gas, made in their own gas-producing plant, constructed in accordance with Pinkney's patents.

G. E. STEVENSON.

Manchester, May 18, 1895.

A Question as to a Burner Patent.

SIR,—My attention has been drawn to your issue of the 30th ult., in which is published an illustrated description of the patent for a self-regulating gas-burner (No. 2992, Feb. 11, 1895), applied for by Mr. W. Sugg; and I wish to make known that the form of burner there shown is identical with that invented by myself in the year 1879. For this, I was granted provisional protection (No. 807); and large numbers of the burners were made and sold by me about that date.

I am certainly surprised that Mr. Sugg should apply for a patent for such a supposed invention, when he must be fully cognizant that the real merit of the invention rests with myself.

I regret to have to trouble you on such a subject, but I think it my duty to direct the attention of the gas world to the facts.

FRANK WRIGHT.

19 *and* 21, *Old Queen Street, Westminster, May* 17, 1895.

Carbonic Oxide in Water Gas.

SIR,—In replying to the discussion on the paper I had the privilege of reading before the members of the Incorporated Institution of Gas Engineers, I notice that I unfortunately overlooked a point raised by Mr. Methven, to whom I apologize for the omission. It was the possible objection which may be raised to the increased proportion of carbonic oxide in carburetted water gas as compared with coal gas; and as this is a subject on which some appear to feel considerable concern, I trust you will excuse my asking you to grant me space in the JOURNAL for this letter, which will, I hope, be of some interest in reference to the matter.

The old saying that "there is nothing new under the sun" is well exemplified in this case; the objection to carbonic oxide being very ancient history on the other side of the Atlantic, where repressive legislation was tried years ago, and given up as a foolish and unnecessary hindrance to a beneficial and convenient system of artificial lighting. It will be extremely regrettable if this history should repeat itself here, and the British Parliament of the present time adopt restrictions which are now obsolete in America, where experience has shown them to be both needless and undesirable.

The question cannot be said to be a new one either, so far as we are concerned; and, on this account, I trust I may be excused for looking back 22 years, and calling attention to some interesting experiments by Dr. Louttit, which were reported to the British Association of Gas Managers by the late Mr. R. P. Spice during a discussion on a paper prepared by Mr. H. Gore. I append an extract from the Transactions of that Association for 1873, chronicling the matter.

Though these experiments are not recent, they are as convincing to-day as they were then; and I trust that, by recalling them to mind, I may help to remove some of the prejudice which American gas history proves to be due to want of familiarity.

A. E. BROADBERRY.

Tottenham, May 11, 1895.

[ENCLOSURE.]

The experiments were tried upon rabbits, which, at the present moment, were alive and well after partaking of a considerable portion of this gas in the state in which it was delivered to the public.

Experiment No. 1.—Bell jar filled with a mixture of coal gas and air—1-12th coal gas, 11-12ths air. Rabbit put in; result as follows: 15 seconds, eyes twitching; 30 seconds, breathing hurriedly; 1 minute, breathing hurriedly, eyelids rapidly twitching; 1½ minute, dropping of ears, with slight convulsive movements; 2 minutes, continuation of the same; 2½ minutes, increased convulsive movements, moving about in jar; 2 minutes 45 seconds, sitting quietly in jar; 3 minutes, the same; 3½ minutes, the same; 4 minutes, breathing very hurriedly; 4½ minutes, moving in jar, pupils dilated; 5 minutes, suddenly became collapsed and comatose. The rabbit was then removed from the jar, and recovered as follows: In 1 minute 10 seconds, gradually recovering, breathing quietly; 2 minutes, pupils beginning to dilate; breathing normal; 3½ minutes, moving about, but with a little difficulty; 5 minutes, recovered, running about looking but little worse for the inhalation of the gas. No sign of paralysis.

Experiment No. 2.—Bell jar containing a mixture of water gas and air—1-12th water gas, 11-12ths air. Rabbit put in; result as follows: 30 seconds, no perceptible result; 1 minute, moving in jar; 2 minutes, lying quiet, no convulsions; 2½ minutes, becoming comatose, slightly convulsed; 3 minutes, lay down in jar, breathing hurriedly; 3½ minutes, quiet, partially comatose, but now breathing quite normal; 4 minutes, twitching of lips and tongue (not protruding); 4½ minutes, the same; 5 minutes, the same; 10 minutes, comatose. The rabbit was then removed from the jar, and recovered as follows: In 1 minute, pupils contracting, breathing becoming normal; 2 minutes, moving head about; 4 minutes, sitting up (there had been *no* paralysis of hind extremities); 5 minutes, the rabbit had entirely recovered, and appeared in no way hurt from the inhalation of the gas.

Experiment No. 3.—Bell jar containing a mixture of coal gas and air—quarter coal gas, three-quarters air. Rabbit put in; result as follows: 5 seconds, screaming; 1 minute 15 seconds, strong convulsions; 1 minute 25 seconds, collapsed to bottom of jar; 1 minute 30 seconds, comatose, with convulsions; 1 minute 45 seconds, completely comatose. The rabbit was removed from the jar, and recovered as follows: In 45 seconds, breathing hurriedly, paralysis of hind extremities; 2 minutes, breathing becoming normal; 3 minutes 30 seconds, sitting up and recovering; 5 minutes, moving about; 8 minutes, quite recovered.

Experiment No. 4.—Bell jar containing a mixture of water gas and air—quarter water gas, three-quarters air. Rabbit put in; result as follows: 28 seconds, slight convulsions; 33 seconds, convulsions; 45 seconds, the same; 1 minute, comatose; 1 minute 52 seconds, completely comatose. The rabbit was then removed from jar, and recovered as follows: In 30 seconds, began to exhibit symptoms of returning animation; 45 seconds, sitting up on hind legs; in 3 minutes, running about quite recovered.

Experiment No. 5.—Bell jar containing a mixture of coal gas and air—half coal gas, half air. Rabbit put in; result as follows: 3 seconds, screaming; 12 seconds, pupils contracting, eyelids moving spasmodically; 15 seconds, ears dropping, gasping for breath; 30 seconds, convulsions; 34 seconds, fallen to bottom of the jar, all the extremities perfectly paralyzed, back doubled; 1 minute, screaming faintly; 1 minute 5 seconds, completely comatose. The rabbit was then taken out of the jar, and recovered as follows: In 6 seconds, convulsive twitching of all extremities; 12 seconds, the same; 20 seconds, perfectly comatose, breathing normal, slight convulsive movements, pupils dilating and contracting, extremities still partially paralyzed. It remained in that state until the expiration of five minutes, when it began gradually to recover, and in a quarter of an hour was sitting up, but did not shake off the effects for fully half an hour.

Experiment No. 6.—Bell jar containing a mixture of water gas and air—half water gas, half air. Rabbit put in; result as follows: 30 seconds, convulsions; 45 seconds, fallen to bottom of jar; 50 seconds, lying quietly at bottom of jar, and breathing hurriedly; 1 minute 10 seconds, perfectly comatose, paralysis of *hind* extremities only. The rabbit was then removed from the jar, and recovered as follows: In 30 seconds, breathing in short gasps, screamed faintly; 45 seconds, continued screaming slightly, pupils dilated; 1 minute, breathing hurriedly; 1 minute 30 seconds, eyelids rapidly twitching; 1 minute 45 seconds, ears twitching; 2 minutes 45 seconds, breathing quite normal, opening and closing eyelids, still partially paralyzed in hind extremities; 5 minutes, moving; 10 minutes, attempted to sit up, but failed; 18 minutes, sat up, animation returning; 20 minutes, running about; at the expiration of 30 minutes, there was no apparent paralysis of hind extremities, and the rabbit appeared perfectly well and hearty.

The jar used in my experiments was a bell-shaped glass jar, about 2 feet high and 1 foot in diameter. The rabbits were healthy young ones about three months old. The experiments were performed in the presence of Mr. Sharp, my assistant, and several superintendents of Mr. Ruck's works at Greenwich.

I think that I have proved conclusively that carbonic oxide gas in the presence of hydrogen is, at least, not more poisonous than the carburetted hydrogen gas. These rabbits were the subjects of frequent experiments, were soon after, and now are, gambolling about as healthy and strong as if they never were the innocent recipients of the debated poisonous properties of the two gases. This subject is a matter of extremely interesting scientific investigation, and can be performed by anyone capable of conducting the experiments properly.

(Signed) JAS. LOUTTIT, M.D., M.R.C.S., &c.

Greenwich, May 20, 1873.

P.S.—Since writing the above, I am glad to see in the JOURNAL OF GAS LIGHTING of the 3rd of June inst., that, in reply to a very able paper read by T. Wills, Esq., F.C.S., before the Society of Arts, Mr. H. P. Stephenson said that "Messrs. Frankland and Wright made experiments some years ago, in order to ascertain the effect of carbonic oxide upon animal life, as compared with the effect of ordinary coal gas. They experimented upon two rabbits of about the same age and weight; and the results of their experiments were that carbonic oxide is not more poisonous than ordinary coal gas." I am glad to be able to confirm the accuracy of the experiments made by the above-named distinguished gentlemen, and also to prove that carbonic oxide, either alone or mixed with air in varying proportions, is not more poisonous to animal life than ordinary coal gas in the same proportions.

(Signed) J. L.

June 6, 1873.

A considerable mistake [said Mr. Spice] had been made on this subject. He had taken the opportunity to ask Dr. Odling, and afterwards Dr. Frankland: "Do you see any objection to the use of this gas as a means of lighting ordinary apartments?" Dr. Frankland's answer was, "None whatever;" and Dr. Odling's, "Not the least."

Messrs. John Wright and Co. and the De Mare Incandescent Light Company, Limited.

Messrs. John Wright and Co., Limited, ask to be allowed to state, through the JOURNAL, that, though their name appearing upon the prospectus of the above-named Company has in some instances led to the supposition that they are connected with it, the connection is purely a personal one of their London Manager (Mr. Smith), and does not in any way apply to them.

Extension of Gas Lighting in South Africa.—We learn, from South African papers recently to hand, that the Grahamstown works of the South African Lighting Association have been successfully inaugurated; and that the town is now, for the first time in its history, provided with a supply of coal gas. The works are of very substantial and adequate character. They have been designed by Mr. Corbet Woodall, and erected and started under the immediate superintendence of his son, Mr. H. Woodall. The occasion of their inauguration was celebrated by a banquet attended by many prominent residents, who expressed their obligations to the Company for carrying out this enterprise, which it is to be hoped may prove an advantageous one to both residents and shareholders. The Contractors for the works were Messrs. S. Cutler and Sons, of Millwall, London.

New Joint-Stock Companies.—The Acetylene Illuminating Company, Limited, has been registered with a capital of £21,000, in £1 shares, to enter into an agreement with Mr. Samson Fox for the acquisition of licences and privileges mentioned therein, and to carry on business as manufacturers of electric smelting and other furnaces, engineers, &c. The De Mare Incandescent Gas-Light System, Limited, is the title of a Company formed with a capital of £100,000, in £1 shares, to adopt and carry into effect an agreement expressed to be made between the Société Anonyme des Brevets Etrangers de l'Héliogène of the first part, Frederick de Mare of the second part, J. M. Caton of the third part, and the Company of the fourth part; and, generally, to carry on business as manufacturers of, and dealers in, incandescent lights and other apparatus for increasing the illuminating power of gas, spirits, oil, and other light and heat producing agents, and as electrical, mechanical, and general engineers, gas-fitters, &c. The Water-Pressure Accumulator Syndicate, Limited, has been registered with a capital of £10,000, in £1 shares, to enter into an agreement with Mr. W. J. Cordner for the acquisition of certain patents, patent rights, &c., and to develop and turn them to account.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following progress was made with Private Bills last week:—

Bills read the first time: Bray Township Improvement Bill, Bridlington and Quay Water Bill.
Bill read a second time: Gas Orders Confirmation Bill.
Bills reported: Hayward's Heath Gas Bill, Whitby Water Bill.
Bills read the third time and passed: Hayward's Heath Gas Bill, North Middlesex Gas Bill.
Opposition withdrawn: Whitby Water Bill.
Bills Royal Assented: Bristol Water Bill, British Gaslight Company (Staffordshire Potteries) Bill, Felixstowe and Walton Water Bill, Newmarket Gas Bill.

HOUSE OF COMMONS.

The following progress was made with Private Bills last week:—

Bill presented and read the first time: London Water-Works Transfer (Money) Bill.
Bill read a second time and committed: Local Government Provisional Order (Gas) Bill.
Bill reported: Ambleside Urban District Council Gas and Water Bill.
Bills read the third time and passed: Bridlington and Quay Water Bill, Edinburgh and District Water Bill.

HOUSE OF COMMONS COMMITTEE ON LONDON WATER BILLS.

(*Before the Right Hon.* D. PLUNKET (*Chairman*); *Sir* J. KITSON, *Sir* H. STAFFORD NORTHCOTE, *Mr.* BALDWIN, *Mr.* BURNIE, *Mr.* MUNTZ, *Mr.* P. STANHOPE, *Mr.* AINSWORTH, *and Mr.* HOLLAND.)

First Day—Tuesday, May 14.

The proceedings on the four Water Bills referred to the above Committee—viz., the Lambeth and Southwark and Vauxhall (Transfer) Bills, promoted by the London County Council, and the Lambeth and Chelsea Water Bills, promoted by the two Companies named—were opened to-day. The first Bill to be taken was the

LAMBETH WATER (TRANSFER) BILL.

Mr. BALFOUR BROWNE, Q.C., Mr. WORSLEY TAYLOR, Q.C., Mr. FREEMAN, Mr. KEMP, and the Hon. F. THESIGER appeared for the promoters. The various petitioners against the Bill were represented as follows: The proprietors and debenture-holders of the Lambeth Water Company, by Mr. PEMBER, Q.C., Mr. CRIPPS, Q.C., Mr. H. A. RIGG, and Mr. RICKARDS; the Southwark and Vauxhall Water Company, by Mr. POPE, Q.C., Mr. BIDDER, Q.C., and Mr. BAGGALLAY; the West Middlesex Water Company, by Mr. PEMBER, Q.C., Mr. CRIPPS, and Mr. RICKARDS; the East London and Grand Junction Companies, by Mr. PEMBER, Q.C., and Mr. CRIPPS, Q.C.; the Kent Water Company, by Mr. LITTLER, Q.C., and Mr. COWARD; the New River Water Company, by Mr. POPE, Q.C., Mr. BIDDER, Q.C., Mr. LITTLER, Q.C., and Mr. BAGGALLAY; the Chelsea Water Company, by Sir W. MARRIOTT, Q.C., and Mr. BAGGALLAY; the Surrey County Council, by Mr. COWARD; the Middlesex County Council, by Lord R. CECIL; the Kent County Council, by Mr. PEMBER, Q.C., and Mr. CLARKE WILLIAMS; the Essex County Council, by Mr. H. C. RICHARDS; the Hertfordshire County Council, by Lord R. CECIL; the Beckenham Urban District Council, by Mr. PEMBER, Q.C., and Mr. CLARKE WILLIAMS; the Wandsworth District Board of Works, by Mr. J. D. FITZGERALD; and the Waltham Holy Cross Urban District Council, by Mr. J. W. BATTEN. Petitions were also presented against the Bill (but no Counsel appeared in their support) by the West Kent Main Sewerage Board; the Corporation of Croydon; the St. George's, Hanover Square, Vestry; the Conservators of the River Thames; the Wimbledon, Woodford, Buckhurst Hill, Erith, Barking, Bromley, East Ham, Wanstead, Hornsey, Acton, Ilford, and Walthamstow District Councils; the Corporations of London, West Ham, and Kingston-on-Thames; the Croydon, Bromley, Sevenoaks, and Dartford Rural District Councils; the Vestry of St. Marylebone; Messrs. Maple and Co. and Messrs. Shoolbred and Co.; the Junior Constitutional Club; and the Merton Parish Council.

On the Southwark and Vauxhall (Transfer) Bill, the same Counsel appeared for the promoters; and there were 37 petitions against the Bill, mostly from the bodies mentioned above, but including also petitions from the Corporation of Richmond and the Officers and Servants of the Company—no Counsel being yet instructed on these petitions.

On the Lambeth Water Bill, for the extension of the Company's works and the increase of their capital, Mr. PEMBER, Q.C., Mr. CRIPPS, Q.C., Mr. H. A. RIGG, and Mr. RICHARDS appeared for the Company; and there were petitions against the Bill by the Corporations of London and Croydon, the London County Council, the Thames Conservators, the Lambeth Vestry, and the Surbiton District Council.

On the Chelsea Water Bill, Mr. PEMBER, Q.C., and Mr. RICKARDS were for the Company; and the petitioners against the Bill were the Corporation of London, the London County Council, the Thames Conservators, the London and South-Western Railway Company, and the Surbiton District Council.

Mr. BALFOUR BROWNE, in opening the promoters' case, said that the County Council were promoting two Bills—one for the transfer of the Lambeth Water Company's undertaking into the hands of the County Council, and the other for the Southwark and Vauxhall undertaking. Though he was going to speak mostly upon the Lambeth Bill, the principles which underlay the one would underlay the other; and he supposed the Committee would like to hear the evidence about both transfers, which would save recalling witnesses, and be the shorter process. In the words used by Sir John Lubbock, the scheme propounded was the greatest municipal scheme ever brought before Parliament; and he hoped that it would result in the passing of certain Bills, which would be exceedingly beneficent to the water consumers of London. The rejection of the various Instructions to the Committee which had been moved in the House would, he hoped, clear the ground of points raised by many of the petitioners. The provisions of the Bill were simple. Clause 3 authorized the transfer by agreement; clause 4 provided that, failing agreement, the undertaking should be vested in the Council on such fair and reasonable terms as might be determined; clause 5 merely provided for the arbitration, which he had no doubt ought to be a strong tribunal; and clause 6—which was all important—provided what the Arbitrator should have regard to in determining the value. There were therefore three matters for the consideration of the Committee: (1) Should the undertakings be transferred? (2) Should the County Council be entrusted with the undertakings; and (3) Were the matters which were to be had regard to by the Arbitrator proper questions for him to deal with, or, in other words, would the terms, if he took those matters into consideration, be fair and reasonable or not. On the first point, he urged that the whole course of legislation showed the necessity of such a transfer. There were very few great towns in England or Scotland, and he believed none in Ireland, where the water was still in the hands of a trading company; the only exceptions being London, Bristol, Newcastle, Portsmouth, and Sunderland. In the case of other large towns, it had been found necessary to give up the supplies which were close at hand, and so go farther afield; and the same thing would have occurred in London long ago, if there had been in existence a body capable of tackling the great water question and the great Water Companies. Now that London had a municipal body that could carry out such a scheme, they were before Parliament to purchase the undertakings on fair and reasonable terms. The learned Counsel then dealt at length with the history of legislation in regard to transfers; and laid especial stress upon the contention that Parliament, in the case of London, had always intended that there should be competition, so as to keep down the rates, but that the Companies, by combination and amalgamation, had succeeded in defeating the object of Parliament, and in getting a monopoly. Parliament did not intend that the Companies should have what they were now seeking to get—a monopoly price, instead of a price having regard to the competitive powers which Parliament had conferred in the interests of the public. In dealing with the eight Companies, it would be found that the ground was in some cases laid twice over, and in others three times, and even more. That was done, as Lord Eldon had said, for the purpose of creating a competition; and if the Companies established a monopoly, Parliament was not incompetent to deal with it. The excuse of the Companies was that that was done a long time ago, and that London had acquiesced in it. He denied that London had acquiesced, as never till 1889 had it an authority which could deal with the Water Companies; and from the very first day of its establishment, it had set itself to become master of the water supply. Sir W. Harcourt's Committee had declared that the monopoly had become intolerable. But Parliament was not unequal to redress such mischiefs in the public interests; and the Council were there to say that there were intolerable mischiefs, and the strongest grounds why the undertakings should be transferred. Counsel then proceeded to refer to a series of Acts granted to the several Companies from 1819 down to the present time, to the various Committees and Commissions which had dealt with the subject, and to the attempts at regulation which had been made under the Acts of 1852 and 1871. He especially dealt with the incorporation of the Lambeth Company in 1785, with a capital of £4800, and power to raise a further sum of a like amount if necessary; to the establishment, in 1805, of the South London Company, and its subsequent amalgamation with the Southwark and Vauxhall Company; and to the fact that competition had been avoided by amalgamation and combination. He said, if the Companies failed to do their duty outside London, the local authority had a right to compete; but, in the interior of London, the only remedy they had was the regulation of the Companies under the Acts of Parliament relating to the Metropolis. Reverting again to the question whether the undertakings should be transferred to the public authority, he said that Parliament had considered the subject over and over again, and on every occasion had said that they should. If this Bill were rejected, there were only two alternatives left—to regulate the Companies, and cut down their charges, or to introduce a new supply of water into London, which would mean competition by the Council with the rates at their back. Either of those alternatives would be far more drastic to the Water Companies than buying them on fair and reasonable terms; and therefore he claimed credit for the County Council that they were proposing the fairest course to the vested interests. Speaking again of the past inquiries into the water question, and to the proposals which were made and accepted by the Companies under Sir Richard Cross's scheme, he said that they were condemned by Sir W. Harcourt's Committee and by Parliament. The Companies wanted an absolutely open arbitration under the Lands Clauses Act; but it was because the Council knew that that would give them an extravagant price that they asked the Committee to consider the terms which they would give to the Arbitrator, and would not ask them to give anything that was unfair or unreasonable. They could not buy the Water Companies on terms which would be more extravagant than those which were condemned by the Metropolitan Board of Works and the Corporation of London, and also by Sir W. Harcourt's Committee. Passing to the inquiry of 1891, he said that the two Bills emanating from the Corporation and from the Vestries were important, in that they showed that those bodies had come to the same conclusion as Parliament had that the Water Companies' works must be transferred. Upon that, in fact, there was an absolute consensus of opinion; and even the Companies accepted this view of the situation when they entered into the provisional agreements with Mr. Smith. There was no difference about the policy; the only question was what they were to be paid If they could get too much out of the ratepayers of London, they would be prepared to abdicate to-day; but it was because the terms were fair and reasonable that they were opposing the present Bills. In the Bills of 1891, there was again a consensus of opinion that the existing works must first be acquired, and that then the water authority

must go for some new supply. New sources of supply would certainly have to be found for London; and he asked who was to do that? The trading Companies for their benefit, or the Municipality for the profit and benefit of the people of London? He pointed out that since 1886 Parliament had adopted the policy of enforcing more stringent provisions in the case of the issue of fresh capital. They had not been allowed to raise it in the way that companies ordinarily did, for the purpose of dividing dividends upon it; but were made to issue the capital as bare trustees for the future purchasers of the undertakings. In the report of the Committee upon the 1891 Bills, he contended that there was for the first time the recognition that the future water authority was not to be an authority separately constituted from the London County Council, but that the Council were to have given to them the duty which they were now seeking, with the sanction of Parliament, to discharge. The learned Counsel was proceeding further to refer to the report of the Committee, when

The CHAIRMAN, intervening, said that, as they could not sit much longer to-day, he might say, for the convenience of Counsel, that the Committee were of opinion that they would follow the first paragraph of Sir Matthew White Ridley's report, and would proceed on the assumption that, in the opinion of Parliament, it is desirable to establish a single public representative Water Authority for the Metropolis; so that, when Counsel resumed, he might proceed with his speech on that basis.

Second Day—Wednesday, May 15.

Mr. BALFOUR BROWNE said that what the Chairman had stated at the close of the previous day very much assisted him; and he took it that, if there was to be a public representative Water Authority for the Metropolis, that Water Authority was to have the undertakings of the Water Companies. As to who the Water Authority should be, he hoped to convince the Committee that it should be the London County Council.

The CHAIRMAN stated that he only intended to convey that the Committee adopted, for exactly what they were worth, the words of the report of Sir Matthew White Ridley's Committee; and he would not have any further construction put upon them at the present time.

Mr. BALFOUR BROWNE, quoting further from the report of Sir Matthew White Ridley's Committee, urged that it was evidently the view of that Committee that the London County Council had duties in relation to water supply. The whole question before that Committee was who should be the Water Authority for London; and the plan which commended itself to them was that the London County Council should be the body to manage the water-works, by means of a Statutory Committee, upon which there should be one representative of the Corporation for every seven of the County Council. Referring to the position of the Local Authorities outside London, he stated that an agreement had, on the previous day, been come to by the County Council for Surrey, by which that body would be able to come and exercise the option of taking over the rights of supply for their own county, together with a certain proportion of the works and mains in their own districts and sources of supply which were not necessary for the supply of London; and the London County Council were willing, upon the same basis, to negotiate with the County Councils of Middlesex, Essex, Kent, and Hertfordshire. Regarding the suggestion that, by proceeding with these two Bills only, the County Council desired to cheapen the undertakings of the remaining Companies, he stated that the Council intended *bonâ fide* to proceed (he did not say when) with the whole of the six remaining Bills; but they declined to give a pledge that, unless the eight Bills were passed, they would drop the whole thing. It would be monstrous if they bound themselves not to take the Bills which this Committee might pass, unless another Committee of Parliament thought they had an equally strong case against all the other Companies. For instance, the Kent Company obtained their water from a pure source of supply; while the Lambeth and Southwark and Vauxhall Companies drew from impure sources. Surely the argument must be different in the Kent Company's case than in that of the Lambeth and Southwark and Vauxhall Companies; and he could quite conceive of Parliament differentiating between that, and saying that the Council should be the owner of the Company distributing impure water, but not of that which supplied pure water. He contended that the report of Sir Matthew White Ridley's Committee disposed of the idea that there should be a Public Trust; and he said that the only one of the petitioners who asked for a Trust was the Wandsworth District Board of Works, who had no right to do it, as they were within the area covered by the County Council as the representative authority for the Metropolis. It was quite evident that great economy would be effected by placing the whole of the Companies in the same hands—especially when it was borne in mind that the Directors' fees amounted to £27,000 a year, and that there were eight separate sets of managers and staffs. To place the management in public hands would also afford the security of a sinking fund, which would mean that the whole of the works would ultimately belong to the community without expense; and this seemed to be one of the main reasons, from a financial point of view, for acquiring the undertakings. Much in future would have to be done for London; and as the Companies were not allowed to raise capital upon ordinary terms, it was hardly likely that any one Company would go to Wales to get water, at an expense of £15,000,000 or £20,000,000, without deriving any profit from it. But if the undertakings passed into the hands of the Municipal Authority, the requisite new works would be carried out in the cheapest possible way, in the interest of the public, by their own representative body. After dealing with the report of the Royal Commission, the learned Counsel proceeded to refer to the Instructions to the Arbitrator as set forth in the Bill; declaring that the County Council distinctly would not buy the Companies under the Lands Clauses Act. It would be grossly wrong if they were to give to the Companies millions of pounds that they did not deserve; and he therefore asked the Committee to modify the Lands Clauses Act—always provided the Companies obtained a fair and reasonable amount for their works. Leaving out altogether the question of necessity of new sources of supply, he urged that the Companies would have to spend very large sums in the immediate future, if they were to carry out the recommendations of the Royal Commission; and though that should be considered by the Arbitrator, it could not be done unless special directions were given. The Royal Commission reported that filth must be kept out of the River Thames, which was a very difficult thing to do; and that therefore inspection was necessary. That was to be done at the expense of the Water Companies; and was not that a fair question to be considered by the Arbitrator? Again, in calculating what the future wants of London would be, the Royal Commission stated that larger storage must be provided; and they gave their approval for a scheme for making reservoirs at Staines, which he believed would cost about £23,000,000. They had also held that the filtration was inadequate; and all that would have to be provided for out of the Companies' capital, without any increase of revenue, which would not make the Companies cheaper to buy. He asked that the Arbitrator should consider these things. As indicating how such expenditure might cripple a Company, he quoted an observation by the Chairman of the Southwark and Vauxhall Water Company, that the Company had expended £3000 on works, but they would be large losers on that £3000 until the year 1895, and that they would not be recouped until 1924. If that was true, how would they provide large works for storage and filtering, without being at a loss? It was their duty, according to the Royal Commission, to undertake those works; and the Arbitrator was therefore bound to consider that the Companies were under this very serious obligation. The question of whether the Companies would also be able to maintain their existing charges, and whether they were charging within their legal powers, as well as the fact that they had not any monopoly, were also matters which should be considered by the Arbitrator. If those two Bills were rejected, and the Council were not allowed to purchase, he would not guarantee that they would not compete with the Water Companies. He was there on a fair errand, offering fair purchase terms; but if they were rejected, it was possible that the other alternative suggested by Sir William Harcourt's Committee might be adopted—the introduction of an independent supply. If they did this, the Companies would be ruined. The Council did not want to ruin the Companies; and that was why they were before the Committee to buy them on fair terms. If the Committee rejected these Bills, the Council would not have to pay the £33,000,000 which it had been estimated the purchase of the Companies would cost, but only the £20,000,000 required to obtain a supply from Wales. They had therefore chosen the fairest scheme to the Companies; and ho trusted it would be accepted by Parliament.

The CHAIRMAN inquired if Counsel proposed to say anything on the third alternative of Sir W. Harcourt's Committee—that of "regulation," which had been advocated by Sir John Lubbock.

Mr. BALFOUR BROWNE replied that he did, to some extent.

The CHAIRMAN said the Committee did not propose to entertain that at all.

Mr. BALFOUR BROWNE said that, if it were necessary, he could show that Sir John Lubbock's scheme would not meet the exigencies of the case at all.

The CHAIRMAN said he did not wish the construction placed upon the observation he made that the Committee were against Sir John Lubbock's scheme.

Mr. BALFOUR BROWNE, proceeding, referred to the storage scheme for reservoirs at Staines, as compensation for the water taken away at Long Ditton and elsewhere, which he said would still leave the population of London to drink the Thames water. But the Thames water was not good enough for London to drink. He should show that distinctly; and the Royal Commission absolutely found that it was the case. If it were not good enough for London to drink, then a new source of supply became of almost immediate necessity; and it was but reasonable that the Arbitrator, in assessing the value of the works, should consider whether the water was fit to drink. The learned Counsel was quoting various resolutions which had been adopted by the County Council upon the water question, when

Sir STAFFORD NORTHCOTE inquired what was the date of one of the resolutions.

Mr. BALFOUR BROWNE said that he was too used to cross-examination not to see the drift of that question; but he urged that, though the resolutions were passed by the County Council which had gone out of existence, there had been no reversal of the policy of the Council since. The only question which had been raised was upon a motion for further inquiry by Sir John Lubbock, which was rejected, for the County Council were sick of inquiry; and the only resolution adopted was one to go on with these Bills. Proceeding further to urge that the directions for the Arbitrator were fair and reasonable, he said that the basis for all such purchases was the net income which the undertaking would produce; but with it must be coupled the element of the probable permanence of the income, or, in other words, what was its security. It was the future of the Water Companies that they were to buy. Their past was gone, and he dared say the money was to some extent spent; and so they could not buy that. It was the future which they took from the shareholders. Therefore was it not a matter for the Arbitrator to consider whether they would get the same income in the future as in the past; and, if they were to secure the same income, whether they would not have to spend more money to obtain it? Unless these matters were considered, it was obvious that the purchaser might buy too dearly. The net income would have to be capitalized at, or multiplied by, a certain number of years' purchase. If it was a bad property, then the number of years' purchase would be small; if a good property, they would be large. If, on the other hand, the income was not permanent, but terminable, it would be absurd to multiply that by the multiplier representing permanency. Suppose part of the income of a Company like that stopped to-morrow, if they capitalized that income on the basis of perpetuity, they would make the purchaser pay probably 32 years' purchase too much. Parliament would not suffer the County Council to do any such unfair thing to the ratepayers. The Local Authority were bound to be just; and he proposed to be just in clause 6, and no more. By this clause, the Arbitrator would get at the real value. If they gave more than the real value, they would be robbing the ratepayers, and giving the shareholders a bonus which they were not entitled to. The Companies might say that they were unwilling sellers; but that, if they were to part with their property, let it be on

terms to be determined by an Arbitrator who should take into consideration all the circumstances of the case. He believed this was what the Companies did now. If that was so—which was his interpretation of what he found scattered about in their petitions—it sounded exceedingly plausible. But the suggestion that they were unwilling sellers was untrue; and if this idea were to prevail, it would probably cost London £2,000,000 extra. The words "upon terms to be determined by an Arbitrator who shall take into consideration all the circumstances of the case," would, however, have the effect of excluding from the Arbitrator many considerations which were essential. If the Companies had neglected repairs, that should be considered, as well as the state of the filter-beds, wells, mains, and plant. If the Lambeth Company possessed double the appliances for filtration that they now had, they would only then be equal to the Chelsea Company; and surely the two incomes should not be taken regardless of this circumstance. Another matter for the Arbitrator to consider was that the mains and pipes ought to be coated or glazed with some preventive composition. Evidence would be laid before the Committee that some of the Companies had pipes so coated; and consequently they would not wear out so soon. The Lambeth Company had not this; and so their pipes were wearing out rapidly. (Laughter.) He did not know why his friends laughed. He was only speaking from instructions; and if it was not proved, it would have to go. Their pipes would have a less life than those of the Chelsea or West Middlesex Company; and without that instruction to the Arbitrator, the Council would be paying for bad pipes upon the same basis as if they were good. As to the condition of the plant, he asked if the Committee were satisfied that the means of distribution were effective. Luckily the long frost had proved that they were grossly inefficient. It turned mainly upon the question of the depth at which the mains were laid. In many cases in London and the outlying districts, the water was cut off by the Companies for some 32 to 60 days; and, in some instances, he believed it was cut off for 80 days. The minimum depth ought to be at least 2 ft. 6 in. At Croydon, where the Corporation were the purveyors of water, the depth was 3 feet; and only one main was frozen. At Bradford, where the minimum depth was 2 ft. 6 in., only one main was frozen. But in London the depth was 18 inches to 2 feet; and in one case of the Southwark and Vauxhall Company, the mains were only 7 inches below the road. Some attempt had been made to lay the blame upon the consumers, by saying that it was not the mains but the service-pipes that were frozen; but if the concern passed into the hands of the County Council, public opinion would be strong enough to make them lay the mains at a proper depth, so that, in such a frost as they had had this winter, they should not be frozen. Then the water-rights of the Companies were also a matter for the consideration of the Arbitrator. The Companies claimed to have larger rights than the Council admitted. Under ordinary circumstances, the Arbitrator would say that he could not go into that question; but they asked that, before the award was made, this should be done.

The CHAIRMAN: We are not going to decide that point, are we?

Mr. BALFOUR BROWNE: No.

The CHAIRMAN: Then I think you need not argue it.

Mr. BALFOUR BROWNE said that the only point of the matter was that the Council thought it important that that should go before the Arbitrator. If it were a mere quibble, the Committee might sweep it away altogether, and say: "What is the good of referring it to the Arbitrator?" If, on the other hand, there was something substantial in it, then it should be considered in the price to be paid. It was only for this purpose that he was referring to the question. It had been contended by the Companies that they were relieved from the obligation not to take more than the 20 million gallons from the Thames, by the agreement which they had made with the Thames Conservancy. But he urged that the Conservancy had no right to sell the water to the Companies; and they therefore could not be called upon to pay for it.

At this stage of Counsel's address, the proceedings were again adjourned.

Third Day—Thursday, May 16.

Mr. BALFOUR BROWNE, resuming his address, stated that he would not say any more as to the County Council being the Water Authority, or as to the question whether there should not be a Water Trust.

The CHAIRMAN said he must not take the Committee as assenting to that view of the matter.

Mr. BALFOUR BROWNE said he did not take the Committee as assenting to anything, but he had laid circumstances before them which were satisfactory to his own mind, however unsatisfactory they might be to the minds of the Committee. Dealing again with clause 6, giving directions to the Arbitrator, he referred to the observations of Sir R. E. Webster, who said that, although he had enjoyed considerable experience of the work of an arbitrator, he frankly confessed that he had never seen any directions which were so one-sided, and so obviously put down for the purpose, not only of enabling the Arbitrator to take into consideration all the circumstances of the case, but entitling him to speculate on matters which no Arbitrator ought to take into consideration. Sir R. Webster's observation might possibly weigh with some members of the House; but if that were true, it would be a very serious allegation. The Lands Clauses Act was only a series of clauses adapted to ordinary cases, which were made a part of Private Bills by incorporation, and were frequently modified and departed from. If they were applied in this case, injustice would be done; and he submitted that clause 6 would do justice between the Companies and the County Council. Speaking again as to the validity of the agreement with the Thames Conservancy to take water from the Thames, he said the Companies sought to get power from Parliament to take 10 million gallons a day; and their application was refused. They then went and made an illicit bargain with the Conservancy, by which they claimed the right to take 20 millions a day. Were they to be bought upon the basis that they had the right to that water, or was the Arbitrator to take the circumstances into consideration? If it was left to a general arbitration, the Arbitrator would not take it into consideration. He did not wish the Committee to put in anything which would preclude the Arbitrator from taking either view. He might find, as a fact, after stating a case for the Superior Court, that the Companies had the right to take the water; and, if so, he would make the Council pay for it. If, however, he did not so find, then the Council would not pay for it. If the County Council adopted the report of the Royal Commission, and refrained from pumping during flood and for some fifteen days after, that would necessitate an expenditure of £21,000,000; while if the Companies continued in possession, they would have to expend that amount, which was also a matter that should be considered by the Arbitrator. If the Companies kept their undertakings, there was practical certainty, or reasonable probability, that they would have to buy a new supply, or be exposed to competition from some authority which should be empowered to provide it; and for that purpose they must incur great expense, which was also a matter to be considered by the Arbitrator. Further, there was what the Commission called a strong sentimental objection against the drinking of the Thames water. Would the community consent for long to drink even suspicious water? If they objected to it, then that would force the Companies away from their present sources of supply. If the sentiment was wrong, and even if the College of Physicians declared that they could drink sewage, would not the Companies have to reckon with the feeling of the people, that, if pure water could be got, they would have it? If, under pressure from that feeling, Parliament cancelled the privilege, as it might do, of obtaining water from the Thames at Long Ditton, what would be the value of the stock in the market? Surely that was a matter which should be considered by the Arbitrator. Speaking of what he described as a haggard physiological experiment tried on London in 1854, when the Lambeth Company had gone up to Long Ditton for their supply, while the other Companies were still permitted to take water from the lower Thames, he said that in the cholera visitation it was shown that the deaths of those who took their water from the lower Thames were 3½ to 1, as compared with the drinkers of the Lambeth water taken from Long Ditton. If there was another cholera epidemic, and, as was admitted, the germs of the disease were carried down by the water, was it likely that the Companies would be allowed to take the water from the Thames in the way which they now did? If these Bills were rejected, he again suggested that the County Council would adopt the alternative of a competitive supply.

The CHAIRMAN: That, of course, would be subject to the assent of Parliament.

Mr. BALFOUR BROWNE said that was quite true; but he only asked that it should be considered as an element, because, if such competition were set up, it would knock the price of the Companies down to nothing. If these Bills failed, and if they could show a strong case for a new supply, he believed they would succeed in getting the consent of Parliament to it. The question of the Companies' rights of charge should also be considered by the Arbitrator. With one exception, the Companies had charged up to their maximum. A man in Putney had the right to be supplied either by the Lambeth or the West Middlesex Company; and if he chose the latter Company, his rates would be 50 per cent. less than those of the Lambeth Company. But by the system of partitioning adopted by the Companies, he was deprived of the right of competition, and compelled to have the Lambeth Company's water at a charge of 50 per cent. more than he ought to pay. He thought that this would not be allowed by Parliament to go on. There was also the question of the charges for gardens, upon which contrary decisions had been given by the Master of the Rolls and Mr. Justice A. L. Smith.

The CHAIRMAN: Do you contend that we are to put into this Bill a clause which will cover every possible case which is, or may be, reversed by some future proceedings?

Mr. BALFOUR BROWNE said he did not; but he asked the Committee to instruct the Arbitrator to consider the legality of the charges. He ought to have power to say that he would send a case to the High Court to consider whether they were legal or not. He was not asking the Committee to decide the legal point. The Arbitrator should consider whether the plant was obsolete or not, and, if so, make a deduction in respect of it. He ought also to deal with the statutory rights of any other Company to compete in the Lambeth Company's district, and the rights of other bodies to supply water, whether existing under statute or as likely to exist in the future. The Companies had frustrated the intention of Parliament by agreeing not to compete; in their agreement with the Thames Conservancy; and in treating the maximum as an inflexible and iron rule of charge. Under these circumstances, competition could commence to-morrow. He reminded the Committee that when the Gas Companies of London were at loggerheads with Parliament, Sir W. Cardwell threatened them with competition from public money; and that, together with the fact that competition could exist, and that any one of these Companies could compete with the other, should be considered by the Arbitrator. Unless the Arbitrator had a direction to that effect, he would not consider it; and therefore on behalf of the Council he urged that such a direction was necessary. Supposing the West Middlesex Company were to agree with the County Council to sell on condition of their full maximum dividends being guaranteed, what would be the result? The Company were charging the lowest rates in London, and they were nevertheless paying their maximum dividend. If the County Council were in the shoes of the Company, they could compete with the Lambeth Company; and it was quite obvious that they could get into the West Middlesex Company's shoes, because the Council were prepared to give the Company more than the undertaking was worth. If the Company were thus bribed to sell their works to the Council, it would not require a large amount to guarantee their maximum dividend of £115,000 per annum. By reason of the Company's powers, they would have a right to supply in the Lambeth, Southwark and Vauxhall, Chelsea, Grand Junction, and New River Companies' districts. If they did this, could the Lambeth Company maintain their present charges? By the purchase of the works of the Company, they could reduce the revenue more than one-half at once; and they would not then be able to pay interest upon their debenture stock. If the Council's fair offer to purchase were rejected, why should this not be done? He knew that it would be a drastic course to take; and therefore they had adopted the fairer method of purchase, and then there would be no competition. This also was a fair matter to be considered by the Arbitrator. If by agreement they

also purchased the undertaking of the New River Company and that of the West Middlesex Company, by means of their powers they could compete over half of London; and they need not buy out the other Companies at all, because such competition would reduce the price of all the other undertakings at once. He also urged that the directions to the Arbitrator as to back dividends, and as to no advantage being taken of any further increase in rateable value, were reasonable; and on the question of no allowance being made for compulsory sale, the Companies were not unwilling sellers. They were perfectly prepared to sell in 1880 at the price agreed; and at some price they were willing to sell now. They ought to be willing to sell now. They ought to be willing sellers at a price which the Arbitrator determined to be fair and reasonable; and they ought not to receive any allowance for compulsory sale, which was an unfair custom which had grown up, which was not always acted upon, and which was not authorized by the Lands Clauses Act. Passing on to deal with the petitions, the learned Counsel remarked that on the first day he supposed the Bar clapped their hands at the array of appearances which were handed in; but the Committee would have noticed that, with regard to most of them, it was announced that Counsel were "reserved"—which Counsel very seldom were. But there were only eight real opponents, and these were the eight Water Companies. One of the most beneficent things which would result from the passing of these Bills would be the termination of the very serious litigation which had been going on for years, which had cost the Companies thousands of pounds, and which had been transferred to the backs of the consumers. The Companies now relied on regulation, which, according to the view of the County Council, was not sufficient, as the Companies had continued to keep to their maximum prices when they said they would not charge them. He did not quite understand what was meant by the statement in the petitions about the Council not having had any previous experience in the management of such undertakings as water-works. The Directors of the Companies did not manage the concerns; they were managed by practical people, who, no doubt, would be quite willing to accept the salaries the Council were willing to pay if the transfer took place. Having commented upon other passages in the petitions, the learned Counsel said that, if the Committee came to the conclusion that the preamble of the Bill was proved, and that the works should be transferred, he did not think there would be any difficulty with regard to the minor points raised. He had put before the Committee what he believed to be a fair case on behalf of the County Council. They did not desire to do anything unfair, but rather wished to resist having put upon them something unfair at the instance of the Water Companies.

Mr. *C. Harrison*, late Chairman of the Parliamentary Committee of the Council, was then examined by Mr. FREEMAN as to the steps which had been taken from time to time by the Council in relation to the water question. Referring to the scheme of the Royal Commission for reservoirs in the Upper Thames, he said there was practically a unanimous expression of opinion by the Council that no more water ought to be allowed to be taken from the Thames Valley, and there was also a very strong feeling, or prejudice—he cared not what it was called—against drinking water drawn from the Thames Valley, which must, to a great extent, be polluted, and could only be rendered potable by filtration of the highest class. The reason the Council decided to proceed with the purchase of eight Bills instead of one was that, not only as regards their physical area, but also their sources of supply, their charges, their liabilities, and numerous other points, the circumstances of the Companies were so different. Another strong point of dissimilarity was that some of the Companies had large areas beyond the county; and while the Kent Company had 174 square miles outside, and the Lambeth Company 62 square miles, the Chelsea had none at all. The difference of area and population had this very important bearing on the question—that, inside the Metropolis, the Valuation Act of 1869 kept the valuation up to its highest point; whereas in the surrounding counties the annual value was not kept up to the same standard. Therefore the Companies supplying outside were doing so on a different standard of annual value from those who were supplying in London; and consequently it was impossible to deal with the eight undertakings collectively in one and the same way.

At this stage, the Committee adjourned until the following day.

The Falmouth Town Council and the Gas-Works.—At a meeting of the Falmouth Town Council on Monday last week, Mr. Webber moved, and Mr. Rusden seconded, the appointment of a Committee to consider the question of purchasing the gas-works. Dr. Banks pointed out that six months' notice would have to be given to the Gas Company in the event of a decision to proceed to the purchase; and he urged that definite action either way be taken within a month. Mr. Fox spoke in opposition to the purchase, on the ground that the Council had so many things in hand. The motion was carried; and a Committee was appointed.

The Proposed Purchase of Goole Gas and Water Works.—Mr. R. Walton, one of the Inspectors of the Local Government Board, held an inquiry at Goole last Thursday into the application of the District Council to borrow £63,000 for the purchase of the undertakings of the Goole and District Gas and Water Company. The Local Board had previously held a third share of the capital. The case of the Council was stated by the Clerk to the Council (Mr. G. England) and Mr. T. Newbigging, of Manchester. A request was made that the repayment of the money should be extended over a period of fifty years. There was no opposition.

The Burnley Corporation Gas Coal Contract.—The Gas Committee of the Burnley Corporation have decided to accept the tender of the Executors of Colonel Hargreaves to supply the total quantity of coal required at their gas-works for the ensuing three years; the price being 10s. 3d. per ton. This compares with 13s. 4d. or 12s. 6d., after the reduction in the miners' wages, for the previous three years. The contract provides for a suspension of deliveries during a strike or breakdown of machinery, but not during a lock-out or stoppage caused by the action of the contractors in varying the rate of wages paid, or the conditions of employment of the workmen.

LEGAL INTELLIGENCE.

READING BOROUGH POLICE COURT.—Thursday, May 9.

(*Before Mr. J. J.* COOPER *and a Bench of Magistrates.*)

The Payment for Water not Supplied Owing to Frost.

To-day the further hearing of a summons taken out by the Reading Corporation against Mr. E. Dear, of Carnarvon Road, Reading, for non-payment of water-rates, was proceeded with. The defendant had declined to pay a sum of 2s. 7d., a portion of his total water-rate, on the ground that for some weeks he was without a supply of water for his bath and garden. The matter had been adjourned to suit the convenience of the Corporation.

The TOWN CLERK (Mr. H. Day) appeared for the Corporation; Mr. DEAR conducted his own case.

Mr. DAY said the matter before the Court, as he understood it, was something to this effect: Mr. Dear did not deny that a water-main existed in Carnarvon Road, or that he had communication-pipes from the main to the several parts of his premises. Nor did he dispute the accuracy of the charges. But he said the main was frozen; and therefore he asked the Justices to order payment of only part of the rate.

Mr. A. A. JONES, the Justices' Clerk, said Mr. Dear stated that he had had no supply of water for his bath and garden, the charges for which for the time he was without water would be about 2s. 6d.

Mr. DEAR said he should like it known that he had tendered the rate, less 2s. 7d. He disputed the charge for the eight weeks for which he was without a supply for the bath and garden. He asked the Bench to make an order for payment of the rate, less 1s. 4d. for the bath and 1s. 3d. garden.

Mr. DAY said these were rents or charges which were not apportionable at law, except when there was a change of occupation, in which case, under section 211 of the Public Health Act, 1875, a rate might be apportioned by the Sanitary Authority, but not by Justices. There were no means of apportioning rates, or periodical payments in the nature of rates. This was a proposition which was laid down as general law in two statutes—the Apportionment Acts of 1834 and 1870. These two Acts were based on the principle that rates and some other periodical payments were not at common law apportionable like interest on money lent in respect of time. He cited a case to show that the water-rate was on the same footing as the general district rate; and he contended that neither the Justices nor the Court had any power to apportion the rate. He had other arguments of a legal nature to adduce, if the Bench did not see their way—which he hoped they would—to take his view of the law on the matter, and at once order the payment of the full rate.

Mr. DEAR said the case quoted was not in point. The Acts under which the Sanitary Authority made their charges for the supply of water did not include the Apportionment Act, which was not at all applicable. The Reading Water-Works Act of 1851 incorporated the Water-Works Clauses Act, 1847, and the Public Health Act, 1848.

In answer to the Chairman, Mr. DAY said he claimed that the water-rate stood on the same footing as the district rate.

Mr. JONES asked if Mr. Day's contention applied to the bath also.

Mr. DAY replied that this was a periodical payment. Section 38 of the Reading Local Board Water-Works Act of 1868 put every sum which the Local Board were entitled to recover on the footing of rates for that purpose; and proceedings might be taken for their recovery. After some further remarks, Mr. Day added that if Mr. Dear had any remedy for the non-supply for the garden, it was not that which he now sought to apply, but it was to take proceedings for enforcing the penalties prescribed by section 43 of the Water-Works Clauses Act, 1847, which was the only remedy the Justices could take cognizance of.

The CHAIRMAN said that, before the Bench decided, they would like to hear Mr. Dear's actual objections.

Mr. DEAR said his contention was that, through no fault of his own, but owing to the freezing of the mains, he had been deprived of the use of his bath for three or four months; and naturally he objected to pay for what he had never received. He paid for the bath apart from the water used for domestic purposes.

Mr. DAY said one of his contentions was that frost was the act of God; and therefore the Corporation were not liable. The Corporation had been put to enormous expense in repairing burst mains.

Mr. DEAR said he would like to mention what he believed was the general feeling in the town—viz., that, owing to the action of the authorities, the water in the mains became stagnant, and froze.

Mr. DAY objected that this was not pertinent to the present case.

Mr. DEAR replied that he was only stating that, as following Mr. Day's remarks in regard to the enormous expense the Corporation had been put to in consequence of the mains having been frozen.

The CHAIRMAN said the Bench would like to have some evidence of what had been done to supplement the supply to these premises during the frost.

Mr. *A. T. Walker*, Assoc.M.Inst.C.E., the Water-Works Manager, was called; and, in answer to Mr. DAY, he said there was communication between Mr. Dear's premises and the main. It had never been cut off by the Corporation as far as he knew; and in a general way, if Mr. Dear did not interfere with the service-pipe, and if it was in good order, he would have the whole force of the water at his disposal. He knew Mr. Dear's service-pipe was frozen before the mains.

Mr. DAY: This state of things was general all over the town?

Witness: Yes.

You did not adopt any process for freezing the water?—No.

And you are not responsible for having caused the frost or stagnation in the mains?—No.

Notwithstanding that we are not at fault in the matter of frozen mains and stoppage of supply, were steps taken to remedy or mitigate as far as possible the effects of that stoppage?—Yes, at once.

Questioned more particularly as to what was done in Carnarvon Road, witness said that as soon as it was known that the main was frozen in the road, the men in charge of the water-carts had instructions to go there; and they supplied the people. In the particular case of Mr. Dear, no sooner was the cart in the road than Mr. Dear

took means to supply himself by sending some of his family with buckets, which were filled from the cart. When the cart reached Mr. Dear's house, it stopped there, and a bath was filled with water and carried in. He had every reason to believe Mr. Dear was satisfied with the supply. When it became known that there was no supply from the mains, means were taken to furnish water from carts. No distinction was made in the case of those houses where the water was cut off by reason of the freezing of the service-pipe, and those where the supply was stopped on account of the main freezing. Witness added that he had been in Reading about twenty years, and had never known a similar state of things to that which prevailed last winter. There had not been anything like it for 54 years. The least quantity of water delivered into Reading per head per day in February was 20 gallons. The damage done by the frost would cost the town £2000.

Mr. DAY remarked that he thought it would be more, as the Water Committee had appropriated £3000 from the reserve fund to pay for the damage.

Witness said his figures referred to the period up to March.

Cross-examined by Mr. DEAR, witness said all the mains in the town were not frozen. Had they been so, water could not have been supplied by cart. He did not think they erected a stand-pipe in Carnarvon Road; but there was a general instruction to the men to put up stand-pipes and supply everyone with water.

Mr. DEAR: Did you ever reduce the pressure?

Witness: We cannot reduce the pressure.

How do you come to the conclusion that my service-pipe was frozen?—Because we had a supply in Carnarvon Road; and it was a fact that the service-pipes froze first because they were not so deep as the mains.

The only way in which I could get water was by paying for it.—They did not ask you to pay for it.

Mr. DAY submitted that it would be a most monstrous proposition to give effect to, that a person who had every means of supply to his house from the mains of the Corporation could at any time allege that he was not receiving the supply, if all the means for obtaining it were at his command, as in this case. If this were admitted, there would be never-ending contention, and it would be impossible to carry on an undertaking like the water-works.

Mr. DEAR said Mr. Day had referred to the catastrophe as an act of God. That, as he understood it, was a thing that could not be prevented. He contended that the stoppage of the supply of water could have been prevented by laying the mains deeper.

The Magistrates having deliberated,

The CHAIRMAN said the Bench had very carefully considered the question, and they could not but come to the conclusion that Mr. Dear was practically supplied with water as required by the Act, to the best capacity of the Corporation under the difficult circumstances of the recent frost; and therefore they had no option but to make an order on the defendant for payment of the rate. With regard to costs, as the adjournment had been practically for the convenience of the Corporation, they had decided not to make any order as to costs.

BELFAST QUARTER SESSIONS.—Tuesday, May 7.

(*Before His Honour Judge* FITZGIBBON.)

The Assessment of the Belfast City and District Water-Works.

In this case the Belfast Water Commissioners appealed against an assessment by Mr. J. G. Barton, a Commissioner of Valuation, in respect of the water-works premises; the sum in dispute amounting to £1400 a year, for Grand Jury cess and poor-rate, inside and outside the city.

Mr. J. GORDON, Q.C., and Mr. CAMPBELL, Q.C., appeared for the appellants; Mr. M'INERNEY, Q.C., represented the respondent.

Mr. GORDON, in stating the case for the appellants, said the sole question his Honour would have to determine was whether the property of the Water Commissioners sought to be rated was property of a public nature; and therefore exempted from rating. Up to last December, the Water Commissioners had not been taxed, except for their offices; but at that time, Mr. Barton having been put in motion, set about assessing the taxation. The valuation was made out at something over £17,000 a year, which would give a rate of between £3000 and £3500 a year, certain portions of which would be payable in Belfast as Corporation rates and poor-rates; but outside the city about £1400 a year would be payable in county cess and poor-rate. The latter was a very important matter, because it had to be paid. The money would come out of the pockets of the citizens who paid water-rates. They admitted their liability to the borough rate; but as every penny of their receipts had to be devoted to water purposes, he held that the Commissioners ought to be exempt from county cess and poor-rate, as the Trust they managed was one for the public benefit. With regard to Ireland, the point had never been determined; and he contended that the English authorities had no reference at all to Ireland.

Mr. M'INERNEY argued that under the Act by which the Commissioners were incorporated, they were liable to all "public, parochial, and parliamentary assessments." It had been said that this trust was managed for the public benefit alone, and that the scale of charge was restricted to a stated sum; but, as against that, the Water Commissioners had the power of making special contracts for the supply of water outside the domestic supply; and it should be recollected that £23,000 had been paid in dividends out of the profits last year.

Mr. GORDON remarked that this sum was not for dividends to shareholders; it was simply interest on money borrowed.

Mr. M'INERNEY said that some persons made profit out of it; and the case of a hypothetical tenant came in.

Mr. CAMPBELL replied for the appellants. He said that the money derived from the sale of water was not applied to any private speculation; and even if a higher price was charged for private contracts, that went in reduction of the water-rate for the city. All the moneys were bound to be applied for the sole and only purpose prescribed by the Act of Parliament. The payment of dividends referred to by Mr. M'Inerney was the interest the Commissioners had to pay on the charge capital that was necessary to start their undertaking. He held that the Commissioners of Valuation in thus assessing the Water Commissioners had made a mistake in point of law.

His HONOUR, in giving judgment, said that, the water-works were confined to Belfast; and no person could avail of them unless he came to reside in Belfast. The Water Commissioners had also power to make private contracts. In the 16th section of the Act 15th Vic., such companies and works were only free from rating so long as they were of a public nature, and occupied for the public service. Now, the "public service" meant the whole community; but the water-works were for Belfast alone. The Commissioners had taken premises at Carrickfergus and Stoneyford, in the county, for their filtering-beds; and, by doing so, they had become owners of property in the county. The taxable area in the county had thus been lessened; and if the land had been taken away by the Water Commissioners, he did not see why they should not be taxed for it. It was said that the Trust was one for public benefit; but if the taxable area in the county was lessened, as he had said, instead of benefiting the community, they would be injuring a portion of it. Following upon the judgment in the case of the Harrogate Commissioners, where it was held that the conversion of the wells for the benefit of Higher and Lower Harrogate was not an act for public purposes, he was bound to hold that this case was similar, and that the Water Commissioners were liable to be assessed for county cess and poor-rate.

On the application of Mr. M'INERNEY, his HONOUR granted costs against the appellants.

Proceedings against the South Metropolitan Gas Company for Alleged Illegal Distress.

In the Queen's Bench Division of the High Court of Justice, Mr. Justice Hawkins was occupied last Friday and Saturday, with an action brought by Mrs. H. M. Smith for damages in respect of alleged illegal distress and trespass. The question turned upon the powers of the Company as to the enforcement of payment for moneys due in respect of gas supplied; and they pleaded justification for what they had done. At the outset, the case was heard with a Special Jury; but, in the course of the opening by Mr. Dickens on behalf of the plaintiff, it was arranged, on the suggestion of his Lordship, to withdraw it from them, the question at issue being one of law rather than fact. The plaintiff having given evidence, the case was adjourned *sine die*. A report of the proceedings will be given next week.

The Alliance Gas Company and the Dublin Corporation.

Towards the close of last year, as reported in the JOURNAL at the time, the Alliance and Dublin Consumers' Gas Company brought an action against the Corporation to recover £308 2s. for work done in connection with certain alterations and repairs of the public lighting plant. The defendants lodged £32 in Court, and traversed plaintiffs' claim. In the result, a verdict for £307 18s. was given for the Company; but stay of execution was ordered. A new trial was granted; and the matter came before Justices Holmes and Gibson, in the Queen's Bench Division, last Saturday. Their Lordships gave judgment in favour of the Corporation; Justices O'Brien and Madden, who had heard the arguments, concurring therein. The making of a formal order was postponed till the following sittings. A report of the case is held over till next week.

The Surrey County Council and the Lambeth Water-Works.—At the meeting of the London County Council last Tuesday, the Parliamentary Committee reported that, for some time past, negotiations had been in progress with representatives of the Surrey County Council, with regard to the terms upon which Surrey should acquire, after purchase by the Council, the portion of the undertaking of the Lambeth Water-Works Company applicable to the supply of that part of the county of Surrey which is within the Company's parliamentary area. They had had before them the terms of the proposed agreement as settled; and, subject to some necessary verbal alterations, they had approved it, and directed a copy to be sent to each member of the Council. They recommended that the course taken be approved. This led to a discussion, during which it was urged that Surrey was receiving a much too favourable bargain. Earl Onslow said that, at the meeting of the Surrey County Council that morning, it was decided to accept the agreement. The recommendation was agreed to.

The London County Council and the Water Companies' Undertakings.—As recorded in our "Parliamentary Intelligence," the Bill introduced by the London County Council to obtain authority "to raise and expend money on capital account in connection with the acquisition of water-works"—*i.e.*, the works of the Companies supplying water in the County of London and the neighbourhood, or some of them—has been read the first time. It consists of only two clauses, as follows: "(1) If the undertaking of any Water Company, or any part of any such undertaking, be acquired by the Council under the authority of any Act of Parliament, the Council may expend on capital account for the purposes of such acquisition such money as they may from time to time require to expend for those purposes; and, in order to raise or provide the money required for those purposes, or for other purposes in connection therewith, for which they may be authorized to expend money on capital account, the Council may from time to time create and issue consolidated stock, or resort to the Consolidated Loans Fund, or otherwise raise money, in accordance in each case with the provisions of the Acts for the time in force regulating the raising of money for capital purposes by the Council. The Council shall make provision for the redemption of any stock created, or the repayment of any money borrowed or expended, on capital account for the purposes of this Act, within a period of not exceeding one hundred years from the date of the expenditure of such money, and otherwise in accordance with the provisions, in relation to redemption and repayment, of the Acts relating to the raising and expenditure of money by the Council on capital account. (2) This Act may be cited as the London Water-Works Transfer (Money) Act, 1895."

MISCELLANEOUS NEWS.

BIRMINGHAM CORPORATION GAS AND WATER DEPARTMENTS.

Financial Statements—Railway Rates on Material—Official Rearrangements in the Water Department—The Frost and the Distribution System.

Two important reports will be submitted to the Birmingham City Council at their meeting to-day. One is by the Gas Committee which, besides dealing with various improvements in the plant and increases of salaries, includes a statement giving the results of the working for the half year ending March 31 last. The second report is by the Water Committee, and is of a voluminous character. It treats at great length of the proposed readjustment of the staff of the department, alludes to the effects of the recent frost, and embraces a financial statement for the year ending March 31 last.

In their report, the Gas Committee first refer to the proposed improvements at the works. They state that they have authorized an expenditure of £4695 in the provision of charging and drawing machinery for use in the reconstructed retort-house at Swan Village. The coke screening and conveying machinery employed during the past year at the Windsor Street works having proved to be successful in working, and of great convenience, an extension of it has been authorized at a cost of £1327. The successful introduction of coke-screening machinery at the Saltley and Windsor Street works has made it necessary to provide similar machinery at the Adderley Street works; and it has been decided to provide the plant at an expenditure of £1067. It has been ascertained that it will be advantageous to the department to provide railway waggons for the whole or a portion of the supply of coal to the Windsor Street works, where hoppered waggons only can be used; and the Committee have accepted a tender for 50 steel-hoppered waggons, at a cost of £3450. During the past winter, deficiencies in the supply of gas have been found in some parts of the northern portion of the city—Edgbaston, Erdington, and Handsworth—and an expenditure of £6194 has been authorized in enlarging the carrier mains to these districts. The Committee have given careful attention to the question of appealing against the increased railway rates which they have been called on to pay since the introduction of the Railway and Canal Traffic Act of 1888. By the withdrawal of rebates granted on gas coal, and by the subsequent additions to rates on coal and other materials, the increased annual charge to the department is probably not less than £20,000. As, with few exceptions, the rates paid on materials sent to and from the gas-works are paid by the consignors, the Committee have been somewhat hampered in their desire to make an effort to reduce this largely increased impost. In many cases, the sellers to, and buyers from, the Corporation of such materials are appealing against some portions or the whole of the increased rates; and in such cases the Committee are advised that they are debarred from taking action. After anxious consideration of the whole subject, they have, with the advice of Counsel, lodged claims with the Railway Commission for allowances on rates charged for coal delivered to their private sidings at Saltley and Windsor Street, and have appealed to the Board of Trade against largely increased rates on coke, affecting a considerable tonnage. These appeals will, however, for the reasons stated, only represent a small portion of the total increase in rates since 1888. The Committee have, by the kindness of the Overseers in giving them access to the rate-books for the purpose, been able to bring under the notice of all owners of small houses in the parish of Birmingham the facilities which they are offering for the provision of prepayment meters and gas-fittings in such houses. With but few exceptions, they have, however, failed to interest the owners of the houses in the proposal; and they are now endeavouring to bring it under the notice of the tenants. Up to the present time, they have made but very slow progress in the introduction of these meters in such houses; their experience in this respect being in marked contrast to that in other large cities. In order to meet the wishes of owners and consumers, they have agreed to supply these meters to houses in which fittings will be provided by the applicant, regulating the supply in such cases accordingly. In relation to some of the difficulties experienced in connection with the late frost, the Committee direct the attention of houseowners and consumers to their willingness to prepare, without charge, a specification of the fittings suited to the gas supply required in the building, which could be worked to by any fitter employed by them to do the work. With the co-operation of consumers in this respect, they are confident that much greater efficiency of supply could be secured in all circumstances than is at present possible. The expenditure of the Sick and Funeral Allowance Society in the year ended Dec. 31, 1894, exceeded the income by £91; and this amount has been provided from the general revenue of the department. The Committee have received and considered applications from Mr. H. Hack and Mr. Morrison, the Engineer and Assistant-Engineer at the Saltley works, and Mr. Barrett, Fittings Superintendent, for increases in their salaries. Mr. Hack's salary was last increased in 1889 to £1050; but inasmuch as on this occasion, and on the occasion of his former advance to £950 in 1884, the nominal increases were subject to deductions of allowances made to him, in common with other officers of the Birmingham and Staffordshire Gas Company, in respect of rent of house, gas, fuel, rates, and the payment of income-tax, the actual value to him of his present appointment is not more than £40 over its value in 1882. Since that time, the make of gas at the Saltley and Swan Village works has increased from 1681 to 2433 million cubic feet per annum; and many very valuable improvements in manufacture have been introduced on his suggestion and recommendation, resulting in large additions to the revenue of the department. The Committee have been aware for some time past that Mr. Hack's present salary compares unfavourably with the salaries paid for similar services in other large gas undertakings; but during the last two years, while the department has been working under difficulties, he has, at their request, abstained from pressing his application. Having regard to the responsibilities of his position, and his successful management of the works under his supervision, the Committee now recommend that his salary be increased to £1200 per annum, as from March 31 last. They also recommend the increase of Mr. Morrison's salary from £250 to the maximum of £350; and Mr. Barrett's salary, from £350 to the maximum of £400. In submitting their balance-sheet for the year, the Committee state that they have thought it needful to make some addition to the sinking fund beyond the amount required by Act of Parliament to be set apart annually for this purpose. After appropriating the sum of £24,737 to this purpose, the accounts show a net profit amounting to £30,448. At the request of the Finance Committee, they have agreed to propose that an additional sum of £5000 shall be appropriated to the improvement rate from the profits of the year; and they now recommend that £30,448, including the sum unpaid on the promised amount to the improvement rate of 1893, shall be transferred to the credit of the improvement rate of 1894. They have informed the Finance Committee that they estimate the net profit for the year ending March 31, 1896, at £25,000, in addition to the interest on the reserve fund. The cost of the repairs of meters for the year ended March 31 has been £5809; and the number repaired was 7700. The statistics for the years ended March 31, 1895 and 1894 respectively, show that the sale of gas in 1894-5 was 2,814,020,000 cubic feet; and in 1893-4, 2,667,522,100 feet—an increase of 146,497,900 feet, or 5½ per cent. The total expenditure for the year was £482,473, against £472,423; and the balance of profit, £153,938, against £123,286. The main items of expenditure were £412,378 for the manufacture of gas, £32,479 for distribution, and £23,949 for rent, rates, and taxes. The receipts amounted to £636,412, against £595,709 in 1894. They include £490,847 from the sale of gas, as compared with £455,925; and £140,745 from the sale of residual products, as against £135,395.

The Water Committee's report states that the extraordinary repairs to the engines at Aston, the necessity for which was announced to the Council on June 5 last, have now been completed. The repairs required were very extensive; and the total cost amounted to £2387. The Committee proceed to refer to the existing works and sources of supply. Some time before his retirement, Mr. Gray made a report in which he expressed the opinion that the probable increase in demand for water during the succeeding eight years would necessitate the acquisition of further temporary local sources, and the putting down of additional pumping plant. In view, however, of the non-increase of consumption during the past two years, the Committee did not think it desirable to take any immediate steps on the report. Circumstances, however, have combined to induce the Committee to consult Mr. J. Mansergh and Mr. Henry Davey; and these experts conferred with Professor Lapworth on the subject of the capacity of the Corporation district to yield further underground supplies. The report of these gentlemen confirms and emphasizes the previous opinion given, that a very small margin only is available. In the meantime, the Committee are directing their attention principally to economizing, by using greater stringency in checking the excessive use and waste of water in various directions; and the results already obtained fully justify the measures taken. Regarding the re-arrangements in the staff of the department, the Committee report that, after Mr. Gray's retirement, they appointed his assistants—Mr. T. Raynes and Mr. W. Gray—as Acting Engineers from Jan. 1 until the Committee had decided upon a successor. Mr. Mansergh has proposed a plan by which, by arranging to secure the advice and supervision of Mr. Davey, the work of the department may be carried on by the present staff; the principal proposal in the scheme being that to Mr. Gray, jun., and Mr. Raynes should be entrusted the structural charge of the mains, reservoirs, filters, and generally of the distribution of the water. He also recommends that the Secretary (Mr. Lees) should undertake the general superintendence of the department. In nominating Mr. Davey, Mr. Mansergh has not lost sight of the fact that Mr. Gray is still under the obligation to render service as Consulting Engineer; and it is certain that Mr. Davey will have to frequently confer with him. The Committee recommend that Mr. Mansergh's plan be adopted; believing that efficiency and economy will be secured thereby. Mr. Davey will undertake the discharge of the duties indicated in the report, at a salary of £200, in addition to travelling expenses; but this will not include the remuneration in respect of structural work which he might be asked to carry out. The Committee also recommend the following increases in salaries: Mr. Lees, from £600 to £800; Mr. Raynes, by £100; and Mr. Gray, by £70. Regarding the effects of the severe frost of the past winter on the distribution system, the Committee state that the total number of roads affected by burst mains was 235, with a length of about 55 miles; and the total number of pipes that were found to have been fractured was 2276. The number of streets and roads supplied by the department is about 1766, with a length of 563 miles of mains. The 2276 fractured pipes represent about 3⅜ miles. The total length of main lowered to the end of April was 3944 yards. The cost to the department of temporary supplies and repairs consequent upon the frost has been as under—the account being made up to April 26; Temporary supplies, £4264; repairs of mains damaged by frost, £3799; repairs of meters damaged by frost, £302; lowering and relaying mains, £524—total, £8890. The cost of repairs at the Shustoke reservoir consequent upon the frost was £537; and at Plant's Brook reservoir, about £50. The accounts for the year to March 31 last, show that the cost of the temporary supplies and repairs has reduced the profits by £6910. There is a large increase in rates and taxes. This is accounted for to the extent of £1648 by the altered methods of charging rates which were adopted for the first time in the accounts for last year. The remainder of the increase—£2263—is consequent on the higher assessments of the mains and other properties of the department in the Birmingham and Aston Unions, and is largely attributable to the additional revenue derived from the revision of water-rents. The surplus revenue of last year which was transferred to the special water fund, being chargeable with income-tax, has resulted in an increase of £559 in the amount paid. In the profit and loss account, it is seen that the profit for the year carried to the special water fund is £12,226; being less than that for the previous year by £14,696. The decrease in the balance of revenue account, and the increase in the charges for interest under the 1892 Act, are the principal items constituting the difference. The sum of £2000—the

amount of interest on the reserve fund of £50,000—has been paid to the City Treasurer on account of the borough fund. The revenue account shows water-rents amounting to £179,370; profit on service laying and testing of fittings, £427; rents of land and cottages, £1149; fishing tickets, £253; and transfer fees, £19—total, £181,219. The quantity of water pumped in the year was 5814 million gallons, or a daily average of 15·972 millions, as compared with the previous year's figures of 5996 millions and 16·472 millions respectively. According to the report, progress is being made with the Elan water scheme. The workmen's village has now been practically completed; and the second railway from the Caban dams to Pen-y-Gareg, which is being carried out by the Corporation workmen, has been pressed forward. Excavations have been made, the ground has been opened out, and a temporary waggon road laid for a distance of 3½ miles above the Caban dam; while the permanent-way, sleepers, and the rails have been laid for 7600 feet. The cost of this line to March 31 was £15,381. Considerable purchases of machinery have been, and are being, made for the carrying on of the works. The number of men employed at the end of April was 639.

MUNICIPAL GAS AND ELECTRIC LIGHTING IN BRUSSELS.

The Gas Committee's Report for the Past Year.

At the Meeting of the Municipal Council of Brussels held on the 6th inst., the Gas Committee presented a report for the twelve months ending Dec. 31, 1894. The following is an abstract translation of the document.

The total quantity of gas sold for lighting purposes was 18,119,752 cubic metres, or about 640 million cubic feet; being a falling off to the extent of 500,000 cubic metres, or about 17,650,000 cubic feet, as compared with the sales in the year 1893. This decrease corresponds pretty closely to the loss resulting from the adoption of the electric light furnished from the central station established by the Municipality. There has also been a reduction of consumption consequent upon the employment of Welsbach burners; but this has been compensated for by the accession of 380 fresh customers. On the other hand, the quantity of gas sold for heating purposes and industrial uses has increased by 55,984 cubic metres, or close upon 2 million cubic feet. The total quantity of gas sold was 24,327,657 cubic metres, or 858¾ million cubic feet; being 11¼ million cubic feet less than in the preceding year. The total production of gas reached 30,375,210 cubic metres (1072¼ million cubic feet); and it was disposed of as follows:—

	Cubic Metres.
Night gas, at 14c. per cubic metre	18,119,752
Day gas, at 10c.	3,228,235
Municipal establishments, at 10c.	824,640
Gas-engines, at 10c.	1,399,667
Industrial purposes, at 10c.	413,323
Heating purposes, at 10c.	104,875
Illumination devices, balloons, &c.	191,010
Artizans' dwellings and miscellaneous	46,155
Total sold	24,327,657
Public lighting and illuminations	4,020,249
Used on the works, &c.	1,031,583
Unaccounted for	995,721
Total production	30,375,210

The total expenses amounted to 3,344,159 frs. (£133,766); the receipts, to 4,816,425 frs. (£192,657)—leaving a balance of 1,472,266 frs. (£58,891) in favour of the Municipality. This is 96,132 frs. more than it was in the year 1893; and the Committee attribute the difference to more favourable conditions of working. With regard to manufacturing operations, the coal contracts were renewed as usual last June, at about former rates; but the starting of plant for the production of oil gas has enabled the management to dispense with the richer kinds of coal and cannel. The stock of coke has been cleared off; and the tar will shortly be treated upon the works. This has been already done with the ammoniacal liquor. The spent oxide is regularly disposed of by contract. The amount of capital employed in the gas undertaking at the close of the past year was 18,041,815 frs. (£721,672), as compared with 16,230,922 frs. (£649,237) at the corresponding period of 1893. The total length of mains was brought up to 167,941 metres, or about 184,735 yards, at the end of the year, as compared with 164,868 metres (about 181,354 yards) on Dec. 31, 1893; and of the total quantity of gas passed through them, only 3·28 per cent. was lost by leakage. The number of gas appliances of all kinds fixed last year was 894; bringing up the total to 6476. The number of meters in service at the close of 1894 was 16,686; and of houses provided with interior fittings, 2516. There were 20 additional gas-engines erected; making the total number 263. For the public lighting, there were in use on Dec. 31 last 5790 lamps, of which 582 were fitted with high-power burners. The total number of hours of lighting was 3832. In November last, the Council decided to discontinue the use of double-index meters, and to sell both day and night gas at the uniform rate of 13c. per cubic metre (2s. 11d. per 1000 cubic feet), as from last month. Gas used for heating and motive power, however, will still be sold at 10c. per cubic metre.

The Municipal Electric Light Undertaking.

Our readers may remember that, after considerable delay, a decision was come to by the Brussels Municipality in regard to the establishment of an electric lighting station; and its erection was entrusted to an English Company. The plant commenced running on Nov. 3, 1893. In accordance with the terms of the contract, the contracting Company take all the responsibility, employing their own servants, but at the expense of the city. The result of the first year's operations has lately come before the Municipal Council in a report presented by M. Janssen, the Chairman of the Gas Committee; and we take therefrom the following particulars:—

During the period covered by the report, the mains were extended into streets where applications for a supply of electricity had been made. The necessity for a third "unit," of 500-horse power, having been demonstrated, the order was given for it on Oct. 25 last year, and it was started in the following February. On the 5th of December, a contract was entered into between the State and the City for lighting the principal buildings by electricity. As the result of this agreement, it was considered advisable to erect another station, in the Rue Beyaert, to light the Government Offices, and at the same time the Quartier Léopold and the Quartier Notre-Dame-aux-Neiges. This station is now in progress; and it will be opened in July next. Up to Dec. 31, 1894, the expenses of first establishment amounted to 2,196,832 frs. (£87,873). The total cost of carrying on the undertaking last year came to 83,673 frs. (£3347); and the total returns were 146,549 frs. (£5862)—leaving a gross profit of 62,876 frs. (£2515). The interest and the payments to the sinking fund are thus covered to the extent of 2·28 per cent. of the capital sunk in the works to the end of last year. The cost of the production and distribution of electricity came to 0·035 fr. per hectowatt-hour. The only fuel used is coke, obtained from the Municipal gas-works; and it is charged at 65·7c. per hectolitre (2·75 bushels)—a somewhat lower rate than that paid by private persons. This sale of coke brings in to the Municipality, apart from the benefit to the electric light undertaking, a further profit of some value in connection with the gas undertaking. The total length of streets cabled for the distribution of electricity on Dec. 31, 1894, was 13,981 metres (about 15,380 yards). The number of connections made was 149; and the number of consumers was 146. The number of lamps fixed (reduced to the 16-candle unit), including the public lighting of the Grand'Place and of the Park, is 11,655; being an average of 84 lamps per 100 metres of thoroughfare cabled. The maximum output of the station (on Dec. 22 last) was 2115 ampères; being equal to about 4200 lamps of 16-candle power working simultaneously. This figure corresponds to 36 per cent. of the entire number of lamps fixed. The total sale of electricity to customers was 1,570,527 hectowatt-hours, which brought in 129,510 frs. (£5180), or about an average of 8·25c. per hectowatt-hour. The selling price, originally fixed by the regulations at 10c. per hectowatt-hour, was reduced to 8c. on Aug. 6 last. The electricity required for the lighting of the Hôtel de Ville, "La Permanence," and the King's Palace, has been charged at 5c. per hectowatt-hour. The public lighting by electricity comprises the lighting of the Grand'Place by two lamps of 20 ampères, and of the Park (during the summer) by 32 lamps of 12 ampères each and two of 8 ampères each.

GEORGETOWN (BRITISH GUIANA) GAS COMPANY, LIMITED.

The Half-Yearly Meeting of this Company was held last Tuesday, at the London Offices, 30, Gracechurch Street, E.C.—Mr. CHARLES GANDON in the chair.

The SECRETARY (Mr. S. Wood, F.C.A.) read the notice convening the meeting; and the Directors' report and the statement of accounts—referred to in the JOURNAL for the 7th inst.—were taken as read.

The CHAIRMAN said that at the last meeting of shareholders, which was the first time he had the honour of addressing them from the chair, he had to propose, to his regret, that there should be a reduction of the dividend. He was sorry to say that, on this occasion, he had to do the same thing. The balance-sheet now before them gave the results of the working for the six months to December last, which was also the first six months of the reduction made in the price of gas to private consumers. Unfortunately also the revenue from the public lighting was entirely absent; and therefore he was afraid the account looked somewhat unfavourable. He did not know that any remarks he could make would put a better aspect on the position of affairs; but still there were a few items to which he might refer. On the credit side of the revenue account, no receipts appeared for public lighting; and the private gas and meter rental showed a falling off of £372. This was almost wholly due to the decreased price of gas. The Directors decided to reduce the charge from 14s. 7d. to 11s. 8d. per 1000 cubic feet, which was a reduction of 2s. 11d.; and this accounted for the diminution in the private rental. The number of consumers and the quantity of gas actually sold remained almost the same as for the previous half year; and he still hoped that the lower charge would bring an increase of business. Of course, the reduction was a very heavy one; and they could hardly expect to recover it in the course of the first six months. A reduction was almost inevitable; and it had placed them in a position to compete fairly with the price charged to private consumers by the local Electric Light Company. As he informed the shareholders at the last meeting, the Electric Light Company had taken over the public lighting from July last; so that had gone from them—at all events for a time. With the present price, they could compete with the electric light even with ordinary burners; but if they compared the charge for the electric light with the cost of lighting by the Welsbach incandescent lamp, there was no doubt gas was very much cheaper. Therefore the Directors hoped the inhabitants would patronize gas more largely than they had done. They were also trying to introduce in Georgetown the prepayment meter system, which was found so successful in England. Their Manager (Mr. T. B. Younger) told them that orders had been received for fixing all the prepayment meters so far sent out experimentally; and very shortly they would have to forward another supply. On the debit side of the revenue account, coal had cost £89 less than in the preceding half year. This was, of course, principally due to the smaller quantity used through the loss of the public lighting; and the price per ton was also a little less. Besides this, the receipts from coke and tar had been satisfactory; so that altogether this looked fairly encouraging. He did not think he need make any remarks upon the other items of expenditure. They nearly all showed reductions, which, naturally, they had anticipated on account of the smaller quantity of gas made. The Directors had anxiously considered what economies could be effected under the altered circumstances of the Company; and they had discussed these matters at great length with Mr. Younger (who was on a visit to England, and was present at the meeting). As a consequence, certain suggestions had

been made, which he hoped Mr. Younger would be able to carry out when he returned to Georgetown, and which would result in economies in working. There were certain fixed charges—such as management and office expenses—which it was difficult to deal with. But these also had been considered; and the Directors had come to the conclusion that they would tackle themselves first, and would agree, at least for a time, to a reduction of their fees. They therefore proposed to reduce their fees (they hoped, however, it would not be permanent) from £300 to £200 per annum; and to make some reductions in the official salaries. With these changes, and the improvements they hoped to effect in the working, he thought there was a prospect of a better balance-sheet next time. He concluded by moving the adoption of the report and accounts.

Mr. H. W. Andrews seconded the motion.

Mr. Younger, having been invited to address the meeting, said that the private consumption of gas was keeping about the same; and that to some extent was satisfactory. What they were suffering from was the reduction of 2s. 11d. in the price. This was a big jump down; and if it had not been for this, their profits would have looked very much better. However, with the introduction of the Welsbach burner and prepayment meters, they might recover themselves in time. He was pleased to see the incandescent burner doing so well in England. Walking in the Edgware Road a few nights previously, he noticed how the shops were lighted; and he found that nearly every tenth shop was illuminated with the electric light, and that about the same number were using incandescent gas-burners. But certainly the latter were very much superior to the electric incandescent lights, and considerably more economical. The contract for the public lighting of Georgetown would finish after next year; and he was pretty sure, from what he could gather from the Town Engineer (Mr. Hill), that they would have an opportunity of again taking over a large part of it. Incandescent gas-burners would be better suited for Georgetown than the arc electric lights, owing to the way the town was laid out, with trees on the sides of the streets. Gas was used very little for cooking and heating purposes, owing to the expense. Most of the inhabitants who might otherwise use gas consumed coke, for which the Company obtained a good return; so that one had to be a little judicious in not pushing gas too far for heating purposes. They had a few stoves in use; and they were seeing if they could not push them with prepayment meters. If it was not employed altogether for cooking, gas was a good auxiliary in a hot climate.

The motion was unanimously carried.

On the proposition of the Chairman, seconded by Captain H. Thurburn, dividends were declared on the preference share capital at the rate of 8 per cent. per annum, and on the ordinary share capital at the rate of 3 per cent. per annum, both less income-tax, except upon those dividends payable to the local shareholders.

The Directors retiring by rotation (Captain Thurburn and Mr. Robert Berridge) were re-elected, on the motion of the Chairman, seconded by Mr. Magnus Ohren.

Mr. E. K. Blyth proposed the re-appointment of Mr. Ohren as an Auditor.

Mr. J. Manwaring seconded the proposition; and it was agreed to.

Mr. Ohren, in returning thanks, said he trusted he might be allowed to follow suit with the Directors by taking half his usual fees. He should be glad if the Directors could arrange this.

The services of the various officials were acknowledged; and a vote of thanks was afterwards accorded to the Chairman and Directors.

The Chairman, in responding, referred to Mr. Younger's remarks concerning the incandescent gas-light. He said he remembered some three or four years ago being in Vienna; and he noticed that a large number of gorgeous *cafés* were lighted by electricity. When re-visiting the place last autumn, he found the electric lights had disappeared, and had been replaced by incandescent gas-lamps.

This concluded the proceedings.

CAPE TOWN AND DISTRICT GAS COMPANY, LIMITED.

At the Ordinary General Meeting of this Company, held last Friday, the Directors reported that the quantity of gas made in the year ending Dec. 31 last was 77,911,000 cubic feet; being an increase of 12,165,500 cubic feet on the make in the preceding twelve months, and of 41,652,000 cubic feet as compared with 1890, when the Company was formed. Reference was made in the report to the change in the managership by the appointment of Mr. Sidney E. Stevenson in succession to Mr. W. Arnott. The amount standing to the credit of the net revenue account, including the balance brought forward, and after providing for bad debts and debenture and other interest paid and accrued, was £8932, out of which £2500 (being an interim dividend at the rate of 5 per cent. per annum) was paid in November last. The Directors proposed to reduce the sums standing at the debit of the suspense account and the preliminary expenses account by £2080, and to pay a dividend at the rate of 6 per cent. per annum for the half year ending Dec. 31, 1894. This would absorb £5080, and leave £1352 to be carried forward. In moving the adoption of the report, the Chairman (the Hon. H. Noel) stated that the business of the Company had increased satisfactorily during the past year; the result being that the Directors were able to recommend a higher dividend than they had ever proposed before. In consequence of this increased dividend, the Company's shares stood above par in the market. As far as the future was concerned, what the proprietors had to remember was that South Africa was a district to which the eyes of the whole world were turned; and as Cape Town was the seat of Government, and its population would increase, the demand for the Company's gas would be greater. During the last year the Directors had laid out on capital account no less than £8729; and, in all probability, some further capital would be required shortly. The gross rental during the year amounted to £30,079, as against £23,290 in the previous twelve months; while they had received for their residuals £10,093, as against £7449 in 1893. They were now in a position to pay £1000 off the preliminary expenses, and a similar sum off their suspense account, which made their property much more valuable. Mr. R. A. Fairclough seconded the motion. In reply to a shareholder, the Chairman said the electric light was established at Cape Town; and the Municipality were using it for street lighting in the place of gas. But, as far as the Company were concerned, this would be a benefit to them rather than a loss, as they supplied gas for the purpose at cost price. The report was adopted.

DARWEN CORPORATION GAS SUPPLY.

The Resignation of Mr. T. Duxbury.

Mr. T. Duxbury has received abundant evidence of the high esteem in which he is held by those with whom he has been brought in daily contact during the period he has been Engineer and Manager of the Darwen Corporation Gas-Works—a position which, as our readers are aware, he is now resigning. The Gas Committee have passed a resolution expressing their regret "that Mr. Thos. Duxbury has seen fit, entirely of his own accord, to resign his position as Manager of the Darwen Gas-Works, after seventeen years of successful management; and further express their best wishes for Mr. Duxbury's success in the future." Mr. Duxbury has agreed to continue in office until his successor (Mr. A. H. Smith, of Llandudno) enters upon his duties, on the understanding that he is at liberty to be absent occasionally, if necessary, on his own business.

Mr. Duxbury has also been the recipient of a gold watch and chain. These were presented to him at a complimentary dinner at the Crown Hotel on Wednesday, the 8th inst. The company included several members of the Town Council, Corporation officials, and employees of the Gas Department. The speeches which followed showed the sincere regret with which those present were parting with Mr. Duxbury. Mr. Wardley, in responding to the toast of the Mayor and Corporation, said the members of the Council, with very slight exceptions, had been thoroughly satisfied with the management of the gas-works. The presentation was appropriately performed by the Chairman of the Gas Committee (Mr. Davies); and he spoke of the sorrow which he personally felt that their Engineer was leaving them. He referred to the efforts he and others had made to induce Mr. Duxbury not to relinquish his appointment. But their Engineer had made up his mind; and this being the case, he did not leave anything for the Committee to do but to accept the resignation. They could not know a man, especially one who had the character and held such a position as Mr. Duxbury had filled, and served the town as well as he had done in different degrees, without feeling great pain at parting with him. Mr. Duxbury joined the service of the town when the old Water Company was in existence. He was at first a collector and assistant; and then he became the Secretary and Manager of the Company. In 1872 he left Darwen to go to Accrington, where he pursued his course, rising from the position of Secretary of the Gas and Water Company of that town to be both Secretary and Manager. In 1877, when the position of Gas and Water Manager at Darwen was vacant, Mr. Duxbury received the appointment. He thought Mr. Duxbury would have had a better scope if he had not been so long in his native town. He regretted he should say this; but he was afraid such was the case. Having taking the step he had, the least they could do was to show him some mark of respect. Although there might occasionally have been little differences, so far as he (Mr. Davies) knew the relations between the men and Mr. Duxbury had always been of the most satisfactory; and the relations between him and the Committee, with one or two exceptions, had also been of a cordial nature. They wanted Mr. Duxbury to feel that wherever he might go, and whatever he might be, he carried with him the regard and respect of the officials of the Darwen Gas-Works, the members of the Corporation, and the townspeople, who had known him for so many years. He concluded by handing the watch and chain to Mr. Duxbury, whose health was afterwards drunk with musical honours.

In responding, Mr. Duxbury admitted that he felt he had the confidence of the Corporation with the exception of one or two members, but one in particular. The confidence of that one member he had never been able to get; and he thought he never could have been able to get it, however long he remained at the gas-works or whatever he had done. In his letter of resignation (which had not been allowed to go forth to the public), it was stated why he had resigned; and he thought it was due to the public that they should know what led him to take the course he had. He thought it was a matter of common notoriety that for many years his position had not been a very pleasant one. From time to time, letters had appeared in the newspapers, arising out of what he had said in the Council and elsewhere; and people had told him that, if they were in his position, they would not stand it. He had been disposed to look charitably at things; but still it had been common talk and knowledge that he had not been fairly treated for some time. He had tried to live these things down—he had tried to pass them over as if they had not existed; but it had been very difficult for him very often on a Saturday and Sunday to be out in the streets when in the newspapers on the Saturday there had been letters and statements, and leading articles, reflecting very much upon his character, his honesty, or his ability. ("Shame.") It might have been that he was rather thin-skinned about these things. He had had 17 or 18 years of it; and he felt that it was quite time it should, if possible, be ended. It was not generally known that he had tried to end it in a way which, in his opinion, any gentleman, any Englishman, would have accepted. He thought he would try and end the state of things to which he referred, if it were possible, and have something like peace and comfort in the future. For that reason, he approached, privately and quietly, the individual to whom he referred, and asked him if there was any means of ending the differences that kept cropping up from time to time, ever since that person obtained a seat on the Town Council. Instead of the individual referred to taking this in the light he expected he would do, and saying that he was prepared to let by-gones be by-gones, he turned round and told him that in the past he had only done his duty as a town councillor, that he intended to do his duty in the future, and that he need not expect his

line of conduct towards him (Mr. Duxbury) would be any different than it had been in the past. It was on that last sentence more particularly that everything hinged; and he thought he pointed that out to his Chairman (Mr. Davies) as the "last straw." He believed he had done all that it was reasonable for any man to do; and having no prospect—nothing but the same in the future as he had had in the past—he felt that it was utterly impossible to go through it, nor would he either for the individual to whom he referred or any other person. He could not part from the other members of the Council without expressing his deep gratitude to them for the way they had treated him in the past. If there was any fault he had to find with them, it would be with respect to this particular instance. He did not know how they could have stopped the individual to whom he had referred, but he thought at any rate they might have done so. They might have told him distinctly that, unless he confined himself to fair criticism of the gas-works, there was no more Town Council for him—at any rate that he would have to fight for it, instead of having the support of the whole of the Liberal party on the Council. With regard to the officials, there had been one trouble with the servants at the gas-works. That was the strike; but, if the men were asked, he thought they would say he was not to blame with regard to what took place. With reference to the future, he had not the remotest idea of what it was going to be; but ever since the matter became known, the horizon had been clearing a little. Things had opened up in such a way that he never expected; and without being too confident, he was certainly of opinion that what he had been thinking was the greatest blow of his life so to speak, in resigning his appointment, would possibly turn out to be the greatest blessing he had ever had. He was not yet able to say exactly what the position would be; but he might tell them it was not the management of another gas-works. It was something he believed which would prove to his own advantage, and that of his wife and family. He concluded by acknowledging the kind expressions which had been made and the handsome gift.

Other speeches followed, in all of which the services of Mr. Duxbury were eulogized.

The Working of the Department.

At the last Meeting of the Town Council, Mr. Davies, the Chairman of the Gas Committee, made his annual statement upon the operations of the department. During the past year, he said, they had carbonized 14,149 tons of coals and cannel, against 13,019 tons in 1893-4; and there had been a saving under this head of £1630. This arose largely from the consumption of cannel having been 1000 tons less; the percentage being 14 per cent., as against 22 per cent. The quantity of gas produced per ton of coal was 10,323 cubic feet, against 10,473 feet in 1893-4. The gas unaccounted for amounted to 9,805,000 cubic feet; the percentage being 6·71, as compared with 7·22. Roughly speaking, they had sold 10 million cubic feet of gas more than in the preceding year; the consumption having reached 134 millions. There had been an increase of 5 per cent. in the amount used by small consumers; 12½ per cent. by shopkeepers; 3½ per cent. by mills; and 35 per cent. in the stove consumption. The result of the twelve months' working was a gross profit of £12,952, as against £8900. The gross cost of the gas produced was 1s. 11⅜d. per 1000 cubic feet; and if they deducted the residuals, meter-rents, and miscellaneous receipts, the cost was brought down to 1s. 3·9d. In 1894, it was 1s. 8·30d.; so that this year there was a reduction of nearly 4½d. per 1000 cubic feet. Taking all the gas sold, the average price received was 3s. 3·02d. per 1000 cubic feet. The net increase in the receipts for gas had only been 1½d. per 1000 cubic feet, though 3d. was added to the price last year; this being caused by a larger consumption at 2s. 6d. They had to contribute £9222 for interest and the sinking and depreciation funds, which amounted to 1s. 4½d. per 1000 feet. In 1893-4 their expenditure under these heads was only £8922. The net balance of profit amounted to £3729, which, in his opinion, was very satisfactory, and redounded to the credit of the management of the works. There were 8250 houses in the borough; but as there were only 5000 meters, there must be some 3000 houses where no gas was used. If they could sell another 10 million cubic feet a year, they would be able to reduce the cost still further. The amount of gas supplied for domestic consumption did not vary like that which was used at mills. They found the electric light was constantly taking the place of gas in mills; and they must look more and more to the private houses to supply them with a market for their gas. His principle had been to prevent any increase in the capital account. The gas-works had been heavily weighted in this matter; and he hoped that, when the Committee took the subject into consideration, they would endeavour to divide the money they had at their disposal between making provision for reducing the capital charges and reducing the price at which gas was sold to what it was before the extra 3d. was added. No doubt, the Committee would take into consideration the question of reducing the price before July. The minutes of the Committee were adopted.

STALYBRIDGE CORPORATION GAS SUPPLY.

The Profits of the Department.

The minutes submitted by the Gas Committee at the last meeting of the Stalybridge Town Council contained the annual report of the Gas Manager (Mr. E. A. Loam), and also a resolution appointing a Sub-Committee to deal with the purchase of the coal for the ensuing year and the acquisition of a sulphate plant. Mr. Loam's report was noticed in last week's issue.

Alderman HOLT, in moving the confirmation of the minutes, said it was a little disappointing that there was not a larger balance of profit to show than £196; but he thought, on inquiry, it would be seen that they might take consolation from their having acquired the gas-works. As accounting for the diminution of profit, he said there was an increase of £350 in wages, of £100 in rates and taxes, and the extra assessment represented £144. For coal, something like 2s. a ton more was paid; while for residuals they obtained a less price by a considerable amount. Coke, again, had been at a low figure during the year. He found that this year the total cost for every 1000 cubic feet of gas made, including coal, manufacture, distribution, interest on loans, payments to sinking fund, &c., amounted to 2s. 8·6d. In the previous year, it was 2s. 11·5d.; in 1893, 2s. 11·56d.; in 1892, 2s. 7·7d.; in 1891, 2s. 7·7d.; in 1890, 2s. 6 3d.; in 1889, 2s. 7d.; and in 1888, 2s. 8·7d. For tar and liquor, they had received 12s. 5d. per ton; while in 1894 they realized 10s. 4½d.; in 1893, 9s. 9⅝d.; in 1892, 16s. 11d.; in 1891, 15s. 9d.; and in 1890, 16s. 4⅝d. Therefore in the years when they were getting coal at a less cost, they were receiving as much as 15s. and 16s. per ton for residuals. For the past year the selling price of coke was 7s. 7d., against 9s. 2d. in 1892, and 10s. in 1891; and yet, sailing so near to the wind as they did with regard to the price charged for gas, the profits mainly depended upon residuals, such as coke and other products. He found that during last year they had carbonized a larger percentage of cannel than usual; it being the desire of the Sub-Committee that the quality of the gas should be well maintained. Whereas in 1894 they used 23·59 per cent. of screened cannel, and in 1893 19·75 per cent., in 1890 they only used 16·81 per cent., and in 1889 16·91 per cent. He had taken out from past reports the amounts of profit which had been made; and they were as follows: 1887, £144; 1888, £1851; 1889, £885; 1890, £1222; 1891, £602; 1892, £493; 1893, £66; 1894, £181; 1895, £196. He thought it was desirable that the general public should know whether or not the concern for which they gave such a large amount of money was a paying one. In 1893, when the profit had sunk to £66, the amount anticipated was £1000; but the great coal dispute was in progress, and hence the fall. At the present time, in place of 11½d. received for residuals per 1000 cubic feet of gas, they were only now obtaining from 5d. to 6d.; and while the price of gas used to be 3s. 3d. and 3s. 6d. per 1000 cubic feet, or an average net price, including large consumers, of 3s. 1⅞d., the price was now 2s. 10d., or an average all round price of 2s. 9·1d. The advantages to the ratepayers from the change were as follows: (1) The price of gas was 4⅜d. per 1000 cubic feet less; (2) about £2000 had been paid in relief of the borough rate; (3) they had reduced the loans by £6000; and (4) they had an insurance fund in the bank of £5800. He remembered that two years ago he calculated that the pecuniary advantages to the ratepayers from having acquired the gas-works amounted to more than £23,000. The illuminating power of the gas for the year had been 19 candles; but he regretted very much that the leakage account was still heavy. This, he could assure the Council, caused regret to no one more than to Mr. Loam. The reasons for the tremendous leakage were: First, there was their heritage, the old mains; secondly, they had a scattered district; thirdly, a district of irregular contour; and lastly, they had to keep up a high pressure in order to properly supply that very irregular and scattered district. He also informed the members that small consumers had increased their consumption by 2,688,200 cubic feet.

Mr. TRAVIS seconded the motion.

Alderman MACHELL moved an amendment, referring back to the Committee that portion of the minutes relating to the Sub-Committee, and proposing that it be a recommendation that the whole of the Gas Committee should deal with the coal contracts and the sulphate plant, subject to the ratification of the Council. He also stated that the Gas Manager had repeatedly called the attention of the Sub-Committee and of the Gas Committee to the fact that there was an enormous leakage of gas taking place; but no steps had been taken to prevent it. It was to the prevention of leakage that they must look for their profits.

Mr. DAWSON seconded the amendment.

Considerable discussion ensued, at the close of which,

Alderman HOLT said that, but for the tremendous leakage, they would have shown this year a profit of £600 more.

It was subsequently agreed to alter the amendment so as to make it immediately operative, leaving out the words referring the minute back to the Committee, and making it at once constitute the whole of the members of the Gas Committee the Sub-Committee to deal with the coal contracts. In this form it was adopted.

THE CHESTERFIELD CORPORATION AND THE ACQUISITION OF THE GAS AND WATER WORKS.

The negotiations between the Corporation of Chesterfield and the Chesterfield Water and Gas Company have, it is understood, failed to result in any agreement by which opposition will be avoided to the Bill now before Parliament. In the Company's petition, which will be placed before the Select Committee of the House of Lords appointed to consider the Chesterfield Gas and Water Board Bill, the petitioners state that the Bill is promoted by the Corporation of Chesterfield and the Urban District Councils of Whittington and Newbold and Dunston respectively to carry into effect the decision of the Select Committee of last year so far as it affects the compulsory acquisition of the water and gas undertaking; and although they are not desirous to part with their property, they feel that it is in vain for them, after the decision of the Committee of last session, to oppose in Parliament the principle of that decision. They, however, feel that the Bill does not fairly carry out the decision of the Committee in the manner in which it is proposed to deal with their property. The Bill, they say, constitutes a Joint Board of the Corporation and District Councils, and provides that they (the petitioners) shall sell to the Board, and that the Board shall purchase their undertaking, on such terms and conditions as may be agreed upon, or, failing agreement, as shall be determined by arbitration in the manner provided for by the Public Health Act, 1875, but subject to a special provision that the arbitrators or umpire shall not make any additional allowance in respect of the purchase being compulsory. This provision the petitioners allege is unjust. The Legislature, they point out, has made special provisions in the Lands Clauses Acts for the compulsory purchase of property, and has provided, even under the Public Health Act, that where property is to be taken compulsorily, the Lands Clauses Acts shall be incorporated, which enable

the arbitrators to award such consideration for the purchase as they think fit. The promoters, they contend, seek by the Bill to vary this general practice, which the petitioners humbly submit is neither fair to them nor does it carry out the decision of the Parliamentary Committee. They contend that, if their undertaking—whereby they have supplied the borough and other places with gas and water when the local authorities had no disposition to do so—is to be taken from them compulsorily, the arbitrators should be entitled to consider fairly all the circumstances and prospects of the Company, and make their award accordingly. They also ask that a short and definite period should be fixed within which the Board should complete the purchase of the undertaking; and that the purchase should be effected in the usual manner under the Lands Clauses Acts.

EXHIBITIONS OF GAS APPLIANCES.

In the JOURNAL last Tuesday, brief reference was made to the exhibition of gas appliances held in the Market Hall, Kendal, the previous week. It was promoted by the Corporation Gas and Water Committee, at the suggestion of Mr. Alderman Monkhouse, with the view of bringing before the residents the modern method of substituting in a large measure the use of gas for the old-fashioned coal fire for purposes of cooking principally, but also for heating and power; and they were most efficiently aided by the Manager of the Gas and Water Works (Mr. T. N. Ritson). The stove exhibits were supplied by Messrs. Fletcher, Russell, and Co., Limited, Messrs. Richmond and Co., Limited, and Messrs. J. Wright and Co., Limited; while lighting appliances were shown by Messrs. W. Sugg and Co., Limited, and Messrs. Peebles and Co. A good collection of meters, including those on the automatic prepayment principle, was furnished by most of the well-known makers; and there were a large number of miscellaneous appliances connected with gas and water supply. The exhibits were arranged very effectively; and the hall in which they were displayed presented a pleasing appearance. The utility of the gas cooking stoves was practically demonstrated by Mrs. H. M. Young; while Professor Vivian B. Lewes discoursed on "Flame" and "The Use and Abuse of Coal Gas." The lady evidently impressed her audience with the economy and cleanliness of gas-stoves, for something like 200 were let on hire in the four days of the exhibition; while Professor Lewes added to his already well-earned reputation as a popular lecturer. The exhibition was, on the whole, a distinct success—a result undoubtedly due to the energy displayed by Mr. Ritson, who, on the occasion of the opening of the exhibition, received at the hands of the Mayor (Alderman Wilson) a very hearty recognition of his ability as a gas and water engineer. Messrs. W. Parkinson and Co. held a very successful gas exhibition last week, in the Drill Hall, Nuneaton; Miss Edith Sanderson giving practical demonstrations on cookery twice daily. The Chairman of the Gas Company (Mr. T. P. Iliffe) opened the exhibition with a felicitous speech.

PROPOSED ADDITIONAL WATER-WORKS FOR NOTTINGHAM.

The Water Committee of the Nottingham Town Council are contemplating the carrying out of an important extension of their water-works. In August last year, they instructed their Water Engineer (Mr. D. M. F. Gaskin) to look out for suitable sites for a new pumping-station, and to report thereon; and in November, they invited Professor Hull, F.R.S., F.G.S., to advise them as to the best means of providing additional supplies of water. The reports of these two gentlemen were submitted at the meeting of the Town Council yesterday week; being prefaced by some observations of the Committee. It appears that, for some time past, the Committee have had under consideration the narrow margin between the present water supply and the demand made thereon; and they have observed that there has been a gradual diminution of the supply, and an increasing steady demand. Further, they have found it necessary to abandon pumping at the Zion Hill works, as recent analyses have shown that the water was suspicious, and unsuitable for drinking purposes. The Committee felt that this question must be dealt with without delay; and they therefore took steps to increase the supply at the Bestwood works (at which the diminution was very noticeable), by extending the drifting operations for a considerable distance. These works produced an additional supply of some volume, but still wholly inadequate to arrest the narrowing margin of supply. The Committee therefore concur in the recommendations contained in the reports of their Engineer and Professor Hull as to the acquisition of sites for new pumping-stations and an additional reservoir; and they have entered into preliminary negotiations with the owners of those sites for their acquisition—not necessarily with the view of immediately commencing the whole of the works mentioned, but with the object of utilizing them as required. The Committee are of opinion, however, that one station should be commenced without delay. They therefore asked for authority to acquire the sites on the usual terms and conditions—viz., for the sinking of trial boreholes in the first instance; and, if the results prove satisfactory, then for the erection of permanent works.

The report of the Water Engineer opens with a general statement bearing upon the existing works. The sources of supply are: (1) The Park pumping-station, erected in 1850, and situated in an increasing populous district; the water being extremely hard, and inferior in quality. (2) The Basford pumping-station, erected in 1858, and extended in 1869, the water from which is of good quality, but hard, and the yield 1,956,000 gallons per 24 hours. (3) The Bestwood pumping-station, erected in 1873, the water from which is of excellent quality, and the yield 2,255,000 gallons per 24 hours. (4) The Papplewick pumping-station, erected in 1884, the water from which is also of excellent quality, and the yield 2,334,000 gallons per 24 hours. The total supply from the last three stations (calculating the reliable supply from Bestwood at 2,000,000 gallons) is 6,290,000 gallons per 24 hours. Mr. Gaskin gives some details as to the yields of the wells in previous years, following with a number of figures regarding the consumption of water. He shows that in the year ending March 25, 1881, the quantity pumped and distributed was 1,247,991,611 gallons; that the average daily consumption reduced from maximum weekly consumption was 4,464,935 gallons; that the average daily consumption reduced from minimum weekly consumption was 2,954,666 gallons; and that the supply per head per day for all purposes was 17·82 gallons. The figures for the year ending March 25, 1894, were: Total quantity of water pumped and distributed, 1,808,760,346 gallons; average daily consumption, reduced from maximum weekly consumption, 6,292,468 gallons; average daily consumption, reduced from minimum weekly consumption, 4,069,541 gallons; and the supply per head per day for all purposes, 20·01 gallons.

Information as to the increasing population and number of supplies is given; and then Mr. Gaskin states the capacities of the several high-level covered service reservoirs. They are: Park Row reservoir, 2,202,034 gallons; Belle Vue reservoir, No. 1, 630,928 gallons; Belle Vue reservoir, No. 2, 1,617,440 gallons; Red Hill reservoir, 1,938,876 gallons: Mapperley reservoir, No. 1, 296,874 gallons; Mapperley reservoir, No. 2, 1,526,393 gallons; Papplewick reservoir, 1,487,394 gallons—total capacity, 9,699,939 gallons. The total length of mains laid up to March 25, 1894, was 265 miles. The mean rainfall of the district from 1867 to 1890—24 years—was 26·378 inches. The conclusions drawn by Mr. Gaskin from his investigations point to the fact that the time has now arrived when new supplies should be obtained to ensure a constant supply of water sufficient for some years to come; and this he urges should be dealt with in a comprehensive way by selecting and securing two new sites in the districts east of Bestwood and north-east of Papplewick, with a covered service reservoir on Cockpit Hill, which is situated at an elevation of 508 feet above Ordnance datum, or 67 feet, 78 feet, and 102 feet above the top water levels of the Papplewick, Mapperley, and Red Hill reservoirs respectively. The necessary works to carry the above into effect may, he remarks, be proceeded with afterwards from time to time as the Committee may determine.

Professor Hull's report is, like that of Mr. Gaskin, a lengthy one; and space will not permit of more than an outline of its contents. As a general result of his investigations, he believes he is in a position to recommend a project for obtaining additional supplies sufficient to meet the wants of the population for the next 25 or 30 years, and at a cost which must be regarded as very moderate, considering the interests involved. The success which has attended the sinking of the existing wells is, he says, a strong inducement to proceed in the same direction for the purpose of obtaining fresh supplies; and he deals with the geological conditions which favour such a course. Estimating the population at 363,000 in 1920, and the consumption at 25 gallons per head per day, the quantity of water which will have to be provided will amount to about 9,075,000 gallons per day, which is something like 2,785,000 gallons in excess of the present reliable yield; and this can, he predicts, be easily obtained from two additional pumping-stations. Two modes for meeting the prospective demand for water supply seem available—viz., either by sinking additional wells in the new red sandstone, or by impounding the Dover Beck Springs. In either case, however, the source of supply would be the same—the water from the sandstone formation. The advantages of the former over the latter are: (1) The sinking of one or more wells and pumping water from them will not involve compensation, as underground waters are, by law, common property. On the other hand, impounding the waters of the Dover Beck would involve compensation to millowners and others now using the waters of the stream. (2) The waters of the sandstone rock, drawn from deep sources, are pure, and not liable to contamination. On the other hand, those of the Dover Beck are liable to contamination, especially during floods. (3) Pumping-stations would be less costly in the case here under consideration. On all the above grounds, therefore, an additional supply by means of wells sunk in the sandstone rock is that which, in Professor Hull's opinion, ought to be adopted. The sites which he recommends the Committee to secure are one in the valley of the Dover Beck near Calverton, and the other in some position by the roadside at the Warren, about three miles north-east of the Papplewick pumping-station. The Calverton station should be the first to be commenced; and as Mr. Gaskin has a proposal for constructing a high-service reservoir on Cockpit Hill at a height of 500 feet above Ordnance datum, the station would be conveniently situated for such a reservoir. The Calverton well may be estimated to yield 1,500,000 to 2,000,000 gallons per day; and although it will probably somewhat reduce the supply from the Dover Beck Springs, Professor Hull does not anticipate such a reduction in quantity will seriously affect the millowners along the banks of the stream.

The reports summarized above lately came before the Town Council, and were unanimously adopted.

The former Water Engineer (Mr. L. T. Godfrey Evans) has addressed a letter to the Mayor and Corporation upon the above reports. He says that the technical details of the documents are obviously based upon the results of two years' assiduous labour which he freely gave in maturing plans and arranging statistics for a report to be prepared for the consideration of the Council, when the normal increase in the demand would justify them in asking Parliament for powers to extend the water undertaking. When a similar expensive extension scheme was pressed upon him by influential members of the Water Committee, he resisted it as premature; perferring the approval of his conscience to professional pride in monumental structures, carried out regardless of cost to the ratepayers. He regards the proposal to undertake large expenditure on new pumping-stations as still premature. The reports, he says, prove that each of the existing wells is capable of giving twice the present yield; and the prevention of waste will obviate the necessity of large expenditure on new works for some years to come. In writing this, he asserts that he does not wish to depreciate the work of those who advocate policies for which, in his opinion, the time has not yet arrived; but he asks the members of the Council, when dealing with the reports, not to forget the pioneer work done by him, at the cost of arduous personal investigations and study, and not a little time and money.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Falkirk Gas Commissioners are not allowing the grass to grow beneath their feet in the management of their works. They only came into possession of the undertaking on Feb. 2; and already they have resolved to strengthen their position, notably by the introduction of the Peebles oil-gas process. Following that, they have this week reduced the price of gas from 4s. 2d. to 3s. 9d. per 1000 cubic feet. In the arbitration proceedings in December last, the witnesses for the Corporation took 3s. 5d. or 3s. 6d. as a fair maintainable price for gas in Falkirk. Now, on the one hand, the Commissioners hold out an expectation of being able to reduce the price further next year, so that it is possible they may attain that figure. But, on the other hand, the witnesses spoke without any reference to oil-gas making, and, taking that into account, the Commissioners have not reached their goal by a good way. They have, however, done remarkably well in being able to reduce the price by 5d. per 1000 cubic feet so soon. They seem to have satisfied themselves that they can afford the reduction; for it was only agreed to after consultation with the Manager, who submitted to them figures which showed that they might do it. Mr. Storey, the Convener of the Works Committee, in moving the adoption of the proposal, remarked that they might have recommended a larger reduction; but they thought it better not to sail too close to the wind. Then he went on to say that the gas which the Commissioners were supplying was of a very superior quality to that sent out by the Gas Company, although there was still need for improvement. They were using the best of materials, which cost 6d. per 1000 cubic feet more than those which the Company employed; and he brought out the somewhat curious result that consumers would really have a benefit to the extent of 11d. per 1000 cubic feet. I cannot quite follow this calculation, and I presume the consumers will not see it; but without taking heed of it, the Commissioners have done well in their short period of possession. It is proposed to alter the scale of discounts. Now that the reduction in price has been effected, the Works Committee consider that large consumers should be content with half the amount of discount which they have been getting, and which took about £400 a year off the revenue. Mr. Storey reported that the cost of the transfer amounted in all to £8217, which was made up as follows: Cost of procuring Act of Parliament, £2838; arbitration proceedings, £2509; Court of Session actions, £313; expenses of conveyancing, £770; and the amount awarded to the Arbitrators for expenses, £1785. The Commissioners' expenses in the arbitration were nearly £500 less than those of the Company; and the costs of the Court of Session were much less than they would have had to pay to the Oversman if he had acted. There was naturally some considerable jubilation at the reduction in price; and one member—Bailie Rennie—grumbled at the amount of the costs, but was contradicted by Mr. Storey, who maintained that they did the best they could, acting under the advice of those whom they paid to advise them. The Company, he said, would have preferred very much to have kept their undertaking, which convinced him that the town had made the best bargain, and had been saved from a great monopoly. I am glad they are satisfied.

The Commissioners are not yet out of the Law Courts. As I mentioned several weeks ago, they are litigating with the Gas Company about the price of the conveyance. The case was discussed before Lord Low in the Bill Chamber of the Court of Session to-day. In their application, the Gas Company say that after the award was given in the arbitration, the agent for the town prepared the disposition conveying the undertaking to the Commissioners, and sent it to the agents for the Company, who revised it; and the cost of this—amounting to £207 3s.—they claim from the Commissioners. They found their contention upon section 81 of the Lands Clauses Act of 1845, which provides that all the expenses of the conveyance shall be borne by the promoters of the undertaking. In their answer, the Commissioners take up the position that the purchase was not under the Lands Clauses Act, but under the Falkirk Corporation Gas Act; and that the Lands Clauses Act was only incorporated with the Special Act to the extent of providing the means for fixing the price to be paid. The parties are at variance regarding the facts narrated, as to the terms of the notice to treat, and the like; and Counsel took a long time to clear these up. There need be no wonder at confusion creeping in, for the Counsel for the Company informed his Lordship that in the legal proceedings prior to the arbitration, they were before him on five different occasions. The position of the Company was that the whole proceedings, from beginning to end, were under the Lands Clauses Act, and were for the fixing of the price in a compulsory sale. At various stages they had to safeguard their position lest the Corporation should maintain what they were doing now. The 51st section of the Falkirk Gas Act said: "The Company shall forthwith sell, and the Commissioners shall forthwith purchase, the undertaking of the Company;" and that certainly did not give any countenance to the view that an agreement had been come to, but referred only to the future. For the Corporation, it was said that they were, of course, willing to pay one-half the costs of the conveyance—that was, they were prepared to pay half of the £207; but then the Company were liable to them in one-half of £415 15s., the expenses of the Commissioners' agents in preparing the conveyance, and in one-half of £383 5s., the amount of stamp duty on the deed. The Act which they obtained did not give them the option to purchase or not, but obliged them to do so. In the purchase of the Company's works, they were not "the promoters." Lord Low said that as the case was one of some difficulty, he would take time to consider his judgment.

The total output of gas from the Perth Corporation Gas-Works in their last year was 105,385,200 cubic feet, which is an increase upon the output in the previous year of 8,817,600 cubic feet.

Though the accounts of the Dundee Corporation Gas Department for the past year have not been issued, it is known that a most successful time was experienced. A much larger quantity of gas was made than was estimated; and, what is more satisfactory, the yield per ton of coal was 10,600 cubic feet, as against 10,400 feet in the preceding year. The price of gas is 3s. 4d. per 1000 cubic feet; and there is hope that a reduction may be effected.

In the Dundee Town Council on Monday, a question was also raised as to the expenditure of £150 upon the Gas Commission dinner last year; and it was moved that the sum this year be limited to £50, none but councillors and officials to be present. It was pointed out, however, that this year (the Town Council having taken over the Gas Commission), it would be necessary to invite the gentlemen who were members of the Gas Committee for six months of the year, and who are not in the Council. The motion was accordingly withdrawn, but was threatened to be brought up again next year. Mr. Brownlee said they had every prospect of a good balance on the gas fund this year; and they need have no hesitation on that head.

The workers in the Broughty Ferry Corporation Gas-Works having petitioned for an increase in wages, the Police Commissioners approached the subject from the point of view of the quantity of gas made per man; and they discovered that out of nine other works theirs stood second highest. During the past year the amount expended on the works was £1525; and the Commissioners resolved that the capital sum should be repaid as follows: During the first three years, £188 a year; during the next two years, £108 a year; and during the remaining ten years, £77 a year.

Sulphate of ammonia has now risen to £10 7s. 6d. per ton for spot delivery, and £10 12s. 6d. forward.

The Provisional Order for the supply of electric lighting in Brechin is not to be further proceeded with. I anticipated this was going to happen when the Company who were promoting it began to speak about getting better terms than had been agreed on with the Town Council.

The Edinburgh and District Water Bill, for the bringing in of an augmented supply of water from the Talla Valley, in Peeblesshire, was read a third time in the House of Commons on Thursday. As it has already passed the House of Lords, it now only awaits the Royal Assent. It is matter for congratulation that a measure of such magnitude—the expenditure under it will be nearly £1,000,000—should have passed through Parliament practically unopposed. What opposition was offered was easily disposed of by amicable arrangement. In anticipation of the measure coming into force immediately, the Trustees have this week agreed that Mr. James Wilson, their Engineer, is to be the Engineer of the work, at a commission of 2½ per cent. on the cost. At a meeting of the Trustees on Monday, it was remitted to the Works Committee to carry into effect the provisions of the measure; the desire being to get as much done this season as possible. The first work is the construction of a railway from Biggar up the valley, to the site of the proposed reservoir—a distance of 14 miles There is also some heavy tunnelling work to be done, to get the pipe-track through the range of hills at Leadburn. Six years at least will be required before any water will be available from the new source.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *May* 18.

Sulphate of Ammonia.—Activity in the market has disappeared; and prices have declined from the highest point touched. There are now sellers at £10 f.o.b. at the ports; but buyers are indifferent. As was intimated in the last report, consumers only partly followed the advance, not having much confidence in its permanency in face of the stocks which were understood to exist. No doubt the rapid advance, started by consumers' buying, was mainly occasioned by speculators in their anxiety to cover "bear" sales. Those sales covered, "bears" retired from the market; and re-sales of speculative parcels have had most to do with the decline above indicated. Makers, having relieved themselves of a good portion of their stock, are for the most part fairly easy; but odd ones are pressing, and picking up orders at best prices obtainable. There is still considerable inquiry for forward delivery. But buyers will not now pay the premium demanded; and there does not seem to be much actual business doing in the forward position. Nitrate of soda, in the absence of arrivals and with continued demand, is a shade firmer; and 8s. 3d. is now the lowest for fine quality.

LONDON, *May* 18.

Tar Products.—Pitch marks another slight advance; and it has every appearance of maintaining its position, during the next season at any rate. There is very little stock in this country; and it is reported that fuel makers abroad hold much less stocks than usual for this time of the year. There is a good deal more inquiry for naphthalene; and its use as an insecticide and antiseptic is undoubtedly largely extending. Creosote and common oils are in excess; and prices continue weak. Benzol is again weaker, and both toluol and solvent naphtha are participating in the decline. Anthracene is said to be in better request; but no business of any magnitude is reported, though the position of alizarine warrants the anticipation of a larger consumption of anthracene than has taken place for some time. It is now found that what looked like being serious competitive dyes—viz., nitraniline and nitrosamine—are not likely to seriously affect the use of alizarine. There is now no question of the great superiority as regards stability of alizarine against either of the azo dyes mentioned. Prices are as follows: Tar, 18s. 6d. to 22s. 6d. Pitch, 34s. to 35s. Benzols, 90's and 50's, 11d. Solvent naphtha, 1s. Toluol, 1s. Crude (30 per cent.) naphtha, 4d. Creosote, liquid, 1¼d.; ordinary, 1d.; salts, 20s. Cresylic acid, white, 1s. 2d.; "brown," 11d. Carbolic acid, 60's, 1s. 9d. Anthracene, "A," 1s. 1d.; "B," 10d.

Sulphate of Ammonia.—After a rapid rebound from the lowest recorded price, sulphate is again easier; and prices have fallen under the influence of market operations to £9 15s. to £9 17s. 6d., less 3½ per cent. in all positions. Gas liquor is quoted at 7s. to 8s.

Extensions at the Hindley Gas-Works.—At the meeting of the Hindley District Council last Tuesday, authority was granted for spending £13,500 on extensions at the gas-works; and instructions were given for the preparation of the necessary plans, specifications, and estimates for new boilers, exhausters, washer, purifiers, and gasholder. The alterations will be carried out under the supervision of the Gas Engineer (Mr. W. Dickinson).

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—There is no particularly new feature to report in connection with the coal trade of this district, beyond what I have previously referred to. As regards all descriptions of round coal, the position gradually become, if anything, still more unsatisfactory; and several collieries are not now working more than about three days per week. In many collieries, stocks are already quite as heavy as they care to have on hand, at any rate with the present cost of production; and as a result, the tendency is to restrict the working as nearly as possible to the orders that come forward. The better qualities of round coal are, of course, only in the merest hand-to-mouth request for house-fire purposes. With regard to other descriptions of round coal, the demand still shows no appreciable improvement; and for iron making, steam, and general manufacturing requirements, the lower qualities of round coal still meet with but very slow sale, with prices extremely low to effect anything like clearances. At the pit mouth quoted prices still average about 10s. to 10s. 6d. per ton for the best Wigan Arley; 8s. 6d. to 9s., for seconds Arley and Pemberton four-feet; 7s. 6d. to 8s., for common house coal; and 6s. 6d. to 7s. for steam and forge coals. There is, however, a good deal of irregularity in the open market. With respect to gas coals, what information I get tends to confirm what I have previously written as to the excessive keenness of competition; and 7s. per ton at the pit mouth, for partially screened Arley gas coals, is more than likely to represent quite the full average figure at which contracts will be obtainable. For locomotive fuel, 6s. 3d. per ton at the pit, which is a reduction of 6d. on last year's prices, seems likely to represent the average figure at which these contracts would be taken. Engine fuel, with the limited output, moves off fairly well; but supplies are quite sufficient, and prices are only about maintained at 3s. to 4s. per ton for common, and 4s. 6d. to 5s. for better qualities at the pit mouth. Shipping orders come forward but slowly, with prices at a very low point; ordinary steam coal not fetching above 7s. 6d. and 8s. per ton, delivered at the Garston Docks, or the High Level, Liverpool.

Northern Coal Trade.—A change has come over the coal trade of the North by the opening of ports such as Cronstadt, Lulea, and others in the northern seas—an opening that is beyond the usual date, and that must be expected therefore to cause greater briskness of demand for the shorter season that will thus likely be made. In a week or so, exports will be at a fairly full rate, both for gas and steam coals; and for the latter class, this will in part compensate for the decline in the local demand. Best Northumbrian steam coals are now in much fuller request than they have been of late; and in consequence the collieries are much better employed. The price varies from 8s. 9d. to 9s. per ton f.o.b.; while second qualities are from 6d. to 9d. per ton lower in price, and are also rather easier in demand at present. Steam smalls are a little more abundant, in consequence of the fuller working; but with a better inquiry, the price is steady, at from 3s. 6d. to 4s. per ton. In regard to gas coals, there is a rather better demand; and some of the collieries that have contracts for oversea are taking advantage of the very low range of freights to get tonnage quickly away. Some local contracts for gas coals are being allotted at prices that are equal to from 6s. 3d. to 6s. 6d. per ton f.o.b.—rates that have been practically decided by the London Gas Companies' contracts previously referred to. For odd cargoes, rather higher figures than these have to be paid; but the price of gas coals, it will be seen, is very much below what it was up to three months or so ago. Manufacturing coal is unaltered. Coke is on the whole steadier, with the better tone of the iron trade; and the exports and home consumption is on the whole a little fuller than it was. The price of best Durham coke is from 12s. 6d. to 13s. 6d. per ton f.o.b. There is a lessened demand for gas coke; but the output is now a very low one, and thus it is well taken up. There is no alteration in prices.

Scotch Coal Trade—The trade in Scotland shows no sign of improvement; ell alone being in fair demand. Prices for all varieties are the same as they were two years age, prior to the outbreak of the strike in England. Forward contracting is scarcely to be had; purchasers, both at home and abroad, being convinced that a rise in rates is not probable. The prices quoted are: Main, 5s. 10d. per ton f.o.b. Glasgow; ell, 6s. 9d. to 7s. 3d.; splint, 6s. 3d. to 6s. 6d.; and steam, 7s. 6d. to 7s. 9d. Shipments now begin to compare better with last year, when stacking was rife in anticipation of the strike. For the week, the total was 161,111 tons—an increase upon the previous week of 19,070 tons, and upon the corresponding week of last year of 32,308 tons. For the year to date, the total shipments have been 2,177,760 tons—which is a decrease upon the corresponding period of last year of 408,501 tons.

Brighton Corporation Water-Works.—The Brighton Town Council have accepted a tender for the construction of an engine and boiler house, and other works in connection therewith, at the Patcham pumping-station, for the sum of £2897.

Reduction in Price.—At the meeting of the Hindley District Council last Tuesday, it was unanimously resolved to reduce the price of gas from 3s. 4d. to 2s. 11d. per 1000 cubic feet, and to allow the usual discounts of 20 per cent. to consumers of 150,000 cubic feet and upwards, and 10 per cent. to consumers of less than this quantity per annum, if the gas accounts are paid within a month. The alteration will leave the net prices 2s. 4d. to large, and 2s. 7½d. to small consumers. The reductions are to take effect in the current quarter.

Ware Water Supply.—The water supply of Ware (Herts.) has been for some time declining in quantity; and, in consequence, the Urban Council have retained the services of Mr. E. Bailey Denton, M.Inst.C.E. (Messrs. Bailey Denton, Son, and North), with regard to it. He has recommended the sinking of a deep well and borehole on the low ground of the Lea Valley into the permanent water-bearing stratum of the chalk, and the raising of the water into an existing reservoir on the high ground adjoining the town by means of a gas-engine, in order to supplement the present faulty supply, which is taken from the upper chalk, and the decreasing quantity of which has greatly inconvenienced the malting industry of the town.

Messrs. E. Cockey and Sons, Limited.—In the last number of the JOURNAL (p. 1032), we noticed a sale by auction at which very low prices were realized for some shares and debentures of the above-named Company. We learn that they have since been re-sold privately at about par value.

The Repair of the Water Distribution System at Sheffield.—The Sheffield Corporation Water Engineer (Mr. E. M. Eaton) reported to his Committee on the 1st inst. that the supply of water had been restored over the greater portion of the water area; the principal exceptions being in the fringes of the Sharrow, Heeley, Walkley, Hillsbro', and Owlerton districts. Since the thaw set in, above 800 repairs to cast-iron pipes have been effected; while the new pipes which have been laid, in repairs or renewals, amount to a length of 11,318 lineal yards, or 6 miles 75 yards. The suppression of waste from communication-pipes had not, at the date of the report, been taken in hand, as all the resources of the department had been devoted to restoring the supply of water to the consumers.

Additional Water Supply for Guernsey.—On Thursday, the 9th inst., some additional works which have been carried out by the Guernsey Water Company, with the view of giving the district a more adequate supply of water, were inaugurated by the Governor of the island (General N. Stevenson). They consist of wells situated at a height of 300 feet above the Vale Parish. According to a statement made on the occasion by the Company's Resident Engineer (Mr. G. H. Perryn), one well yields 86,000 gallons, and another 80,000 gallons of water in 24 hours. The water of all the wells—which do not in any way communicate with or affect one another—is pumped into St. Martin's reservoir on a hill at the back of the town of St. Peter Port. The storage capacity of this reservoir is about 380,000 gallons; and there is a fall of 290 feet to the town. The machinery at each of the wells consists of a 7-horse power Priestman oil-engine. The present Company have laid 40 miles of pipes, at a cost exceeding £70,000. They hold practically a monopoly of supplying water. It is in contemplation to construct a reservoir in the Vale, having a storage capacity of 300,000 gallons, for the purpose of supplying the district. In the evening a banquet was held to celebrate the event.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 1079.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	10 Apl.	10½	Alliance & Dublin 10 p. c.	10	21½–22½	..	4 13 4
100,000	10	,,	7½	Do. 7 p. c.	10	14½–15½	..	4 16 9
300,000	100	2 Jan.	5	Australian (Sydney) 5 % Deb.	100	105–107	..	4 13 4
200,000	5	10 May	6½	Bombay, Limited	5	6¾–7¼*	+¼	4 9 8
40,000	5	,,	6½	Do. New	4	4¾–5¼*	..	4 19 2
380,000	Stck.	28 Feb.	11½	Brentford Consolidated	100	243–248	..	4 12 8
180,000	,,	,,	8½	Do. New	100	195–200	..	4 5 0
220,000	Stck.	14 Mar.	11	Brighton & Hove Original	100	220–225	..	4 17 9
888,500	Stck.	28 Feb.	5	Bristol	100	120–123	..	4 1 4
320,000	20	28 Mar.	11½	British	20	51–52	+½	4 6 6
50,000	10	14 Mar.	11½	Bromley, Ordinary 10 p. c.	10	21¼–22½	+½	5 2 2
51,510	10	,,	8½	Do. 7 p. c.	10	16¼–17½	+½	4 17 2
328,750	10	14 Nov.	2	Buenos Ayres (New) Limited	10	6¾–7	+¼	2 17 1
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	100	100–103	..	5 16 7
150,000	20	28 Feb.	8½	Cagliari, Limited	20	26½–27½	..	6 0 0
550,000	Stck.	10 Apl.	13½	Commercial, Old Stock	100	283–288	..	4 13 9
165,000	,,	,,	10½	Do. New do.	100	212–217	..	4 16 9
160,762	,,	13 Dec.	4½	Do. 4½ p. c. Deb. do.	100	130–135	..	3 6 8
800,000	Stck.	13 Dec.	13	Continental Union, Limited.	100	250–255	..	5 1 11
200,000	,,	,,	10	Do. 7 p. c. Pref.	100	205–210	..	4 15 3
535,000	Stck.	28 Feb.	5½	Crystal Palace Ord. 5 p. c. S k	100	120–125	..	4 4 0
486,090	10	31 Jan.	11	European, Limited	10	24–25	..	4 8 0
354,060	10	,,	11	Do. Partly pa d	7½	17–18	..	4 11 9
5,646,590	Stck.	14 Feb.	12	Gaslight & Coke, A, Ordinary	100	270–275	+3	4 7 3
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	105–110	..	3 12 9
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	275–280	..	3 11 5
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	130–135	..	3 14 1
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	197–202	..	3 14 3
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	188–193	+3	3 12 6
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	275–280	..	3 11 5
476,000	,,	,,	6	Do. K, 6 p. c. Prf..	100	163–168	..	3 11 5
1,061,150	,,	13 Dec.	4	Do. 4 p. c. Deb. Stk.	100	129–132	..	3 0 7
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	140–145	..	3 2 1
908,000	,,	,,	6	Do. 6 p. c. do.	100	188–192	..	3 2 6
3,800,000	Stck.	10 May	12	Imperial Continental	100	239–244*	+4	4 18 4
75,000	5	13 Dec.	6	Malta & Mediterranean, Ltd.	5	5¾–6¼	..	4 16 0
560,000	100	1 Apl.	5	Met.of Melbourne, 5 p.c. Deb.	100	110–112	..	4 9 3
541,920	20	14 Nov.	5	Monte Video, Limited	20	15½–16½	..	6 1 2
150,000	5	29 Nov.	8	Oriental, Limited	5	7–7½	..	5 6 8
60,000	5	28 Mar.	7	Ottoman, Limited	5	4¾–5¼	..	6 13 4
166,870	10	14 Feb.	2	Para, Limited	10	1¾–2¼	..	8 0 0
420,000	100	2 May	6	People's Gas of Chicago—1st Mtg. Bds.	100	102–106	..	5 13 2
500,000	100	1 Dec.	6	2nd Do.	100	102–107	..	5 12 1
150,000	10	26 Apl.	7	San Paulo, Limited	10	8¾–9¼	..	7 7 4
500,000	Stck.	14 Feb.	15½	South Metropolitan, A Stock	100	350–360	..	4 6 1
1,350,000	,,	,,	12	Do. B do.	100	293–298	..	4 0 6
290,000	,,	,,	13	Do. C do.	100	307–312	..	4 3 4
775,000	,,	16 Jan.	5	Do. 5 p. c. Deb. Stk.	100	168–173	+1	2 17 10
60,000	Stck.	28 Feb.	11½	Tottenham & Edm'nton, "A"	100	230–235	..	4 17 10
				WATER COMPANIES.				
746,021	Stck.	28 Dec.	10½	Chelsea, Ordinary	100	277–282	+1	3 11 9
1,719,514	Stck.	10 Apl.	8	East London, Ordinary	100	215–220	+3	3 12 9
654,740	,,	28 Dec.	4½	Do. 4½ p. c. Deb. Stk.	100	151–156	..	2 17 8
700,000	50	13 Dec.	8½	Grand Junction	50	107–111	..	3 16 7
708,000	Stck.	14 Feb.	12	Kent	100	304–309	+1	3 17 8
1,043,800	100	28 Dec.	9½	Lambeth, 10 p. c. max.	100	232–237	−1	4 0 2
406,200	100		7½	Do. 7½ p. c. max.	100	200–205	..	3 13 2
330,000	Stck.	28 Mar.	4	Do. 4 p. c. Deb. Stk.	100	136–140	..	2 17 2
500,000	100	14 Feb.	12½	New River, New Shares	100	350–360	−5	3 10 9
1,000,000	Stck.	31 Jan.	4	Do. 4 p. c. Deb. Stk.	100	140–143	..	2 15 11
902,300	Stck.	13 Dec.	6	S'thwk & V'xhall, 10 p.c. max.	100	143–148	..	4 1 0
126,500	100	,,	6	Do. D 7½ p.c. do.	100	138–143	..	4 3 11
1,155,066	Stck.	13 Dec.	10	West Middlesex	100	269–274	+2	3 13 0

*Ex div.

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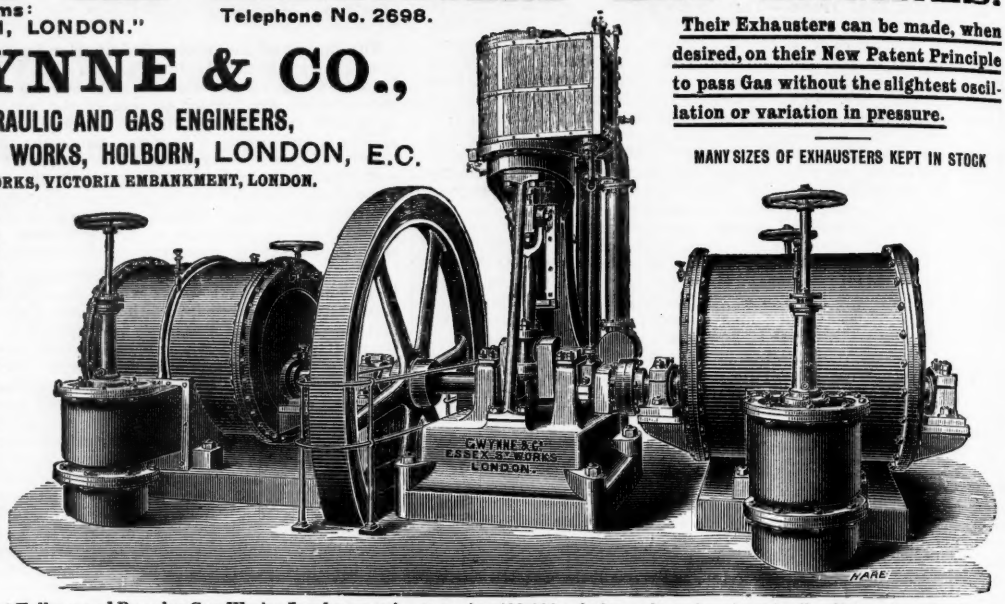

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Apply, by letter only, with Copies of References to HENRY GREENE & SONS, 34, Greyhound Road, HAMMERSMITH, W.

WANTED, by a South Wales Gas Company, a GAS-FITTER, experienced in House Gas-Fitting and Repairing Meters, and in Main and Service Laying.
Applications, stating age and condition, and enclosing copies of three recent Testimonials, to be addressed to No. 2528, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WORKING Manager for Gas-Works carbonizing about 1000 Tons per Year wanted where Regenerators, Exhaust Engine, Scrubber, and Washer are used. Must understand Service Laying and Fitting. House, with Garden, Gas, and Coal free.
Apply, by letter, with full Particulars and Wages asked, to Mr. FRANCIS L. THOMPSON, Secretary, Gas Company, Solihull, WARWICKSHIRE.

GAS TAR Wanted.
TAR DISTILLERY "PERSEVERANTIA," LIMITED, Harlingen, HOLLAND.

WANTED, a good second-hand Station GOVERNOR, 6 inch or 8 inch, with Valves and Bye-Pass Connections, all complete.
Address WM. CARR, 2, Springfield Road, ALTRINCHAM.

WANTED, a second-hand Station METER, in good condition. Capacity, about 40,000 cubic feet per hour.
Address No. 2522, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

BACK-PRESSURE IN PURIFIERS.

THE Valve invented by Mr. Cripps for Bye-Passing any Layer of PURIFYING MATERIAL (referred to by the President of the Incorporated Institution of Gas Engineers in his Inaugural Address) can be obtained of the Makers, Messrs. C. AND W. WALKER, Donnington, SALOP, and Messrs. J. EVERY AND SON, Phœnix Iron-Works, LEWES, to which Firms all inquiries should be addressed.

FOR SALE—Single-Lift Gasholder, 36 feet diameter by 10 feet deep, with Cast-Iron Columns and Counterbalance Weights, complete and in good condition.
Apply to G. HELPS, HINCKLEY.

PURIFIERS.

FOR SALE—Four 8 feet square Purifiers, with Sieves, Bearing-Bars, and Covers. Being removed to make room for larger ones.
Apply to the MANAGER, Gas-Works, Banbury, OXON.

FOR SALE, cheap—One 20,000 cub. feet per hour Beale's EXHAUSTER, with two 8-inch Disc Valves. Also one to pass 5000 Cubic Feet per hour. Both in perfect condition.
Apply to SAMUEL WHILE, 60, Queen Victoria Street, LONDON, E.C.

ST. ANNE'S-ON-THE-SEA GASLIGHT AND COKE COMPANY, LIMITED.

FOR SALE—One Cylindrical Station METER with 6-inch Connections and Bye-Pass; 4000 cubic feet per hour capacity (G. Orme & Co.). Also one 9-inch STATION GOVERNOR, with Valves (Braddock). All in working order.
Offers for same to be addressed to
WILLIAM H. NUTTER,
Secretary and Manager.
Gas Offices, St. Anne's-on-the-Sea,
May 4, 1895.

MATLOCK AND DISTRICT GAS COMPANY, LIMITED.

FOR SALE—A Single-Lift Gasholder, 40 feet diameter, in good order, with Cast-Iron Columns and Counterbalance Weights complete; being replaced by larger one.
Further Particulars may be had on application to Mr. T. Brown, Manager, Gas-Works, Matlock.
Offers to the undersigned.
ROBERT HALL,
Secretary.
Gas Office, Crown Buildings,
Matlock, May 18, 1895.

GASHOLDER, 80 feet diameter by 24 feet deep, in good condition, FOR SALE; being replaced by larger one.
Full Particulars on application to No. 2519, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE—Station Meter, now in use at the Windsor Royal Gas-Works. Capacity 10,000 cubic feet per hour. Being sold in consequence of larger Meter ordered, and which will be fixed shortly.
Offers to be sent to J. H. STRANGE, Secretary, 15, Victoria Street, WINDSOR, by the 3rd of June.

THE URBAN DISTRICT COUNCIL OF STOURBRIDGE.
(GAS DEPARTMENT.)

TENDERS FOR GAS COAL.

THE Gas Committee of the above Council are prepared to receive TENDERS for the supply of about 8500 Tons of good GAS COAL for the next Twelve Months, commencing July 1, 1895.
Particulars and printed Forms of Tender may be obtained on application to the undersigned.
Tenders will be required before Wednesday, June 5.
WM. NORTH,
Engineer and Manager.
Stourbridge Gas-Works,
May 17, 1895.

THE URBAN DISTRICT COUNCIL OF STOURBRIDGE.
(GAS DEPARTMENT.)

TENDERS FOR TAR.

THE Gas Committee of the above Council are prepared to receive TENDERS for the purchase of their surplus TAR, for a period of Twelve Months, commencing July 1, 1895.
Particulars and printed Forms of Tender may be obtained on application to the undersigned.
Tenders will be required before Wednesday, June 5, 1895.
W. NORTH,
Engineer and Manager.
Stourbridge Gas-Works,
May 17, 1895.

BOROUGH OF DEWSBURY.

THE Lighting Committee are prepared to receive TENDERS for the supply and delivery at their Gas-Works, Savile Town, near Dewsbury, of the following quantities of GAS COAL, during a period of One, Two, or Three Years, commencing on the 1st day of July next:—

First Year	17,000 Tons.
Second Year . . .	17,500 Tons.
Third Year	18,000 Tons.

Tenders must specify prices for delivery by Road, Rail, or Water, and be made on forms to be had on application to Mr. Charles A. Craven, Engineer and Manager, Savile Town Gas-Works, Dewsbury, from whom any further Information can be obtained.
Sealed tenders, endorsed "Tender for Gas Coal," to be sent to E. Mawdesley, Esq., Town Clerk, Dewsbury, not later than Saturday, the 25th inst.
The Committee do not bind themselves to accept the lowest or any tender.
By order,
E. MAWDESLEY,
Town Clerk.
Town Hall, Dewsbury,
May 14, 1895.

BOROUGH OF DEWSBURY.

THE Lighting and Water Committee of the above Corporation invite TENDERS for the supply and delivery during the Twelve Months ending the 31st day of August, 1896, of
(1) SULPHURIC ACID.
(2) WET AND DRY METERS.
(3) CAST-IRON GAS AND WATER PIPES.
Specifications and Forms of Tender may be obtained on application to the Gas Engineer, Mr. Charles A. Craven, Gas-Works, Savile Town, Dewsbury.
Tenders, under sealed covers, endorsed "Sulphuric Acid," "Meters," or "Cast-Iron Pipes," as the case may be, to be sent to me not later than Saturday, the 25th inst.
The Corporation do not bind themselves to accept the lowest or any tender.
By order,
E. MAWDESLEY,
Town Clerk.
Town Hall, Dewsbury,
May 14, 1895.

GLOUCESTER GASLIGHT COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of about 23,000 Tons of GAS COAL for One Year from the 1st day of July next, in such monthly quantities as may be required by the Company.
Tenders to state the price delivered at the Midland Railway Wharf, High Orchard, or the Great Western Railway Wharf, Llanthony, Gloucester; or if sent (as preferred) by Water, the price f.o.b., and also the price delivered at the Gas Company's Wharf on the Gloucester and Berkeley Canal.
Further Particulars and Forms of Tender may be obtained of the Company's Engineer, Mr. R. Morland.
Sealed tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal, to be addressed to the Chairman, Gas Offices, Eastgate Street, Gloucester, and delivered not later than Monday, the 10th day of June next.
The Directors reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender.
By order,
WILLIAM E. VINSON,
Secretary.
Gas Offices, Gloucester,
May 9, 1895.

CROMER, NORFOLK.

TENDERS FOR COAL.

THE Directors of the Cromer Gas and Coke Company, Limited, are prepared to receive TENDERS from Colliery Proprietors only, for the supply of 800 Tons of first-class GAS COAL, to be delivered at (*a*) the Great Eastern Railway Station, or (*b*) the Eastern and Midlands Railway Station, Cromer, between the 1st day of June next, and the 31st day of May, 1896. Weight given to be stated.
Deliveries to be made in such quantities and at such times as may be required by the Company.
Payment, net cash monthly.
Sealed tenders, endorsed "Tender for Coal," to be sent to the undersigned, on or before the 1st of June next. Forms of Tender are not supplied.
The Directors do not bind themselves to accept the lowest or any tender.
By order,
P. E. HANSELL,
Secretary.
Cromer, May 15, 1895.

THE URBAN DISTRICT COUNCIL OF LYMM.

THE above Council are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR made at their Gas-Works, for a term of One Year from the 1st day of July, 1895.
The Tar and Liquor will be delivered free into Contractor's Boat on the Bridgewater Canal.
The Purchaser will have to enter into an Agreement with the Council for the due performance of his Contract.
Sealed tenders, stating price per ton for Tar and price per ton for Liquor (5° Twaddel), to be sent to Wm. Mullard, Esq., Clerk to the Council, on or before the 28th day of May, 1895, endorsed "Tar."
The Council do not bind themselves to accept the highest or any tender.
Further Particulars may be had on application to
WILLIAM SEVERS,
Gas Manager.
Lymm, Cheshire,
May 18, 1895.

THE URBAN DISTRICT COUNCIL OF LYMM.

THE above Council are prepared to receive TENDERS for the supply of GAS COAL and CANNEL, to be delivered at their Gas-Works in Lymm, for a term of One Year from the 1st day of July, 1895.
The probable quantities required are about 1200 Tons of Gas Coal, and 250 Tons of Cannel, which must be freshly wrought, and well screened, and free from Sulphurous Pyrites or other objectionable matter; but the Council reserve the right of increasing or decreasing the quantities named.
The person whose tender is accepted will be required to enter into an Agreement with the Council for the due performance of his Contract.
Sealed tenders, stating price per ton delivered alongside the Works, to be sent to Wm. Mullard, Esq., Clerk to the Council, on or before the 28th day of May, 1895, endorsed "Coal and Cannel."
The Council have no special Form of Tender, and do not bind themselves to accept the lowest or any tender.
Further Particulars may be had on application to
WILLIAM SEVERS,
Gas Manager.
Lymm, Cheshire,
May 18, 1895.

SUTTON-IN-ASHFIELD URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

TENDERS FOR COAL, TAR, AND AMMONIACAL LIQUOR.

COAL—The Gas Committee of the above District Council are prepared to receive TENDERS for the supply of 2800 Tons of well-screened GAS COAL, to be free from Shale and Pyrites, and to be delivered at the Town Station, Sutton, in such quantities as the Manager shall from time to time direct between July 1, 1895, and June 30, 1896.
TAR AND LIQUOR—TENDERS for the surplus TAR and AMMONIACAL LIQUOR produced at their Works from July 1, 1895, to June 30, 1896.
Tenders, stating price per ton of 20 cwt. at the Works or at Sutton Town Station.
Tenders, endorsed, to be addressed to the Chairman of the Gas Committee, District Council Offices, Sutton-in-Ashfield, so as to arrive not later than the 4th day of June, 1895.
Particulars and other Information may be obtained from Mr. A. Clarke, Gas-Works, Sutton-in-Ashfield.
By order,
G. H. HIBBERT,
Clerk to the Committee.
District Council Offices,
Sutton-in-Ashfield, Notts.,
May 16, 1895.

SUTION-IN-ASHFIELD URBAN DISTRICT COUNCIL.
(WATER DEPARTMENT.)

SUPPLY OF COAL.

THE Water Committee of the above District Council are prepared to receive TENDERS for the supply of 600 Tons of best HARD COAL SCREENINGS, to be delivered at the Mansfield Railway Station, or at their Pumping-Station at Rushley, Nottingham Road, in such quantities as the Manager shall from time to time direct, between July 1, 1895, to June 30, 1896.
Particulars and other Information may be obtained from Mr. A. Clarke, Gas-Works, Sutton-in-Ashfield, Notts.
Tenders, endorsed "Coal Screenings," to be addressed to the Chairman of the Water Committee, District Council Offices, Sutton-in-Ashfield, so as to arrive not later than Tuesday, the 4th day of June, 1895.
By order,
G. H. HIBBERT,
Clerk to the Committee.
District Council Offices,
Sutton-in-Ashfield, Notts.,
May 16, 1895.

DARWEN CORPORATION GAS-WORKS.

TO TAR DISTILLERS.

THE Gas Committee of the above Corporation are prepared to receive TENDERS for all the surplus GAS TAR produced at their Gas-Works for One Year ending March 31, 1896.

Sealed tenders, endorsed "Tar," to be sent to me not later than Twelve Noon, May 27 inst.

CHAS. COSTEKER,
Town Clerk.

May 11, 1895.

BOROUGH OF EAST RETFORD.

THE Gas Committee of the above Corporation are prepared to receive TENDERS for the supply of 4500 Tons of the best screened GAS COAL, to be delivered during the Year ending June, 1896.

Sealed tenders to be sent in to the Chairman of the Gas Committee, endorsed "Tender for Coal," not later than the 31st inst.

The Committee do not bind themselves to accept the lowest or any tender.

Any further Particulars may be had from the undersigned.

J. B. FENWICK,
Manager.

Gas and Water Office, Retford,
May 17, 1895.

BOROUGH OF EAST RETFORD.

THE Gas Committee of the above Corporation are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR produced at their Works during the Year ending June, 1896.

Tenders to be sent in to the Chairman of the Gas Committee, endorsed "Tender for Tar" or "Liquor," on or before the 31st inst.

Any further Information may be had from the undersigned.

J. B. FENWICK,
Manager.

Gas and Water Office, Retford,
May 17, 1895.

ROCHESTER, CHATHAM, AND STROOD GASLIGHT COMPANY.

SUPPLY OF GAS COALS.

THE Directors invite Tenders for the supply of about 40,000 Tons of GAS COALS, to be delivered between the 1st of August, 1895, and the 31st of July, 1896.

Further Particulars, with Forms of Tender and Contract, may be had on application.

Sealed tenders, marked "Coals," are to be delivered to me at these Offices, not later than Noon of Thursday, the 6th of June, 1895.

J. M. VEEVERS,
General Manager.

Gas Offices: 95, High Street, Rochester,
May 9, 1895.

SOUTH SHIELDS GAS COMPANY.

TO COALOWNERS.

THE Directors of the South Shields Gas Company invite TENDERS for the supply of 40,000 Tons of clean, unscreened GAS COAL, for delivery, into Craft, and at the Company's Depôt, South Shields, as required, over a period of Twelve Months.

The Directors reserve to themselves the right of taking the Coal in one or more lots.

The lowest or any tender not necessarily accepted.

Particulars as to Deliveries, &c., may be obtained at the Gas-Works, on application to Mr. W. J. Warner, the Engineer.

Sealed tenders to be delivered to the undersigned not later than Friday morning, the 24th inst., endorsed "Tender for Coal."

J. H. PENNEY,
Secretary.

Gas Offices, Chapter Row, South Shields,
May 13, 1895.

SOWERBY BRIDGE URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

THE Gas Committee of the Sowerby Bridge Urban District Council are prepared to receive TENDERS for the supply of 11,000 Tons of best GAS COAL and 1000 Tons of CANNEL required in each year for One, Two, or Three Years from June 1, 1895.

Specifications and Forms of Tender can be obtained by applying to Mr. John Marsland, Engineer and Manager, Gas-Works, Sowerby Bridge.

The Gas Committee do not bind themselves to accept the lowest or any tender.

Tenders must be sent in not later than Monday, May 27, 1895, endorsed "Tender for Coal" or "Cannel" respectively, and addressed to

GODFREY RHODES AND EVANS,
Clerks to the Council.

Commercial Bank Chambers,
Halifax, May 7, 1895.

SOWERBY BRIDGE URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

THE Gas Committee of the Sowerby Bridge Urban District Council are prepared to receive TENDERS for the supply of 1220 yards of 6-inch Turned and Bored CAST-IRON PIPES required for the Gas-Works.

Also DIGGING TRENCH for same, &c.

Specifications and Forms of Tender can be obtained by applying to Mr. John Marsland, Engineer and Manager, Gas-Works, Sowerby Bridge.

The Committee do not bind themselves to accept the lowest or any tender.

Tenders must be sent in not later than Monday, May 27, 1895, endorsed "Tender for Pipes" or "Digging" respectively, and addressed to

GODFREY RHODES AND EVANS,
Clerks to the Council.

Commercial Bank Chambers,
Halifax, May 7, 1895.

TENDERS FOR GAS COALS.

THE Directors of the Exmouth Gas Company are prepared to receive TENDERS for the supply of 2500 Tons of Screened or Unscreened Fresh-Wrought GAS COALS.

Tenders to be for price f.o.b. and c.i.f., at Exmouth Docks, between the 1st of July next and the 30th of June, 1896, accompanied by Working Analysis.

Sealed tenders, addressed to the undersigned, and endorsed "Tender for Coal," to be sent in not later than the 1st day of June, 1895.

The Directors do not pledge themselves to accept the lowest or any Tender.

By order,
JAMES T. FOSTER,
Secretary.

Gas-Works, Exmouth,
May 9, 1895.

BOROUGH OF SAFFRON WALDEN.

TENDERS FOR COALS.

THE Gas Committee are prepared to receive TENDERS for the supply of about 1000 Tons of GAS COAL, and the Water Committee for the supply of about 180 Tons of best picked STEAM COAL, respectively, delivered free at Saffron Walden Railway Station, at such times and in such quantities as shall be required, during the period of Twelve Months between the 1st of July, 1895, and the 30th of June, 1896.

The prices to be for 20 cwt. to the ton; and the tenders must state the name and locality of the Colliery from which it is proposed to supply the Coals.

Sealed tenders, endorsed "Tender for Gas Coal," and "Tender for Steam Coal," as the case may be, to be sent to me not later than Monday, the 10th of June next.

The Committees do not bind themselves to accept the lowest or any tender.

G. WILLIAM LACEY,
Borough Surveyor.

May 16, 1895.

THE URBAN DISTRICT COUNCIL OF HAVERHILL.

TENDERS FOR COAL.

THE Council invite Tenders for the supply of 1200 Tons of the best screened GAS COAL, to be delivered free at Haverhill Station during the period of One Year from the 15th day of June next.

Delivery will be taken from time to time as the Manager shall require same.

The Council reserve the right to divide the Contract into two of 600 Tons each.

Tenders, in sealed envelopes, endorsed "Tender for Coal," should be addressed and sent to me, the undersigned, not later than the 4th day of June next.

By order,
SIDNEY H. GRAHAM,
Clerk to the Council.

Haverhill, May 16, 1895.

THE Paignton Gas Company hereby invite TENDERS for the supply of 4000 to 5000 Tons of NEW PELTON, PELAW MAIN, or BOLDON GAS COAL during the period of One Year from the 1st of June next.

All persons submitting tenders must state the price per ton delivered free at Paignton Railway Station; and the person whose tender is accepted will be required to deliver the Coal in quantities of not less than 500 Tons for each of the following Months: October, November, December, January, February, and March; and the balance in such quantities as the Directors may determine.

Sealed tenders, marked "Tender for Coal," should be addressed and sent to the undersigned not later than Tuesday, the 28th inst., before Six o'clock on that day.

FREDK. W. PUDDICOMBE,
Secretary.

5, Victoria Street, Paignton, Devon.

KNARESBOROUGH URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Gas Committee invite Tenders for about 2000 Tons of unscreened GAS COAL for delivery, in Contractor's Waggons at Knaresborough Station, in such monthly quantities as may be required, for a period of One, Two, or Three Years, commencing July 1 next.

Particulars may be obtained on application to the Manager, Mr. T. Settle.

Tenders, stating price per ton, endorsed "Tender for Coal," and addressed to the Chairman of the Gas Committee, must be sent in on or before the 29th of May, 1895.

The Committee do not bind themselves to accept the lowest or any tender, and reserve to themselves the right to apportion the whole quantity as they may think fit.

By order,
THOMAS MAINMAN,
Clerk to the Council.

May 8, 1895.

KNARESBOROUGH URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the purchase of the surplus TAR and LIQUOR produced at their Works for One Year commencing July 1 next. The same will be delivered in Buyer's Tanks at the Railway Station, Knaresborough.

Price per ton for Tar (separate); price per ton for Liquor per degree from 5° upwards.

Coal carbonized, about 2000 Tons per annum.

The Committee also invite TENDERS for the supply of about 80 Tons of good LIME, free from Dirt and Ashes, delivered fresh at Knaresborough Station.

Tenders, stating price per ton, endorsed "Tar and Liquor" or "Lime" as the case may be, and addressed to the Chairman of the Gas Committee, to be sent in on or before the 29th of May, 1895.

By order,
THOS. MAINMAN,
Clerk to the Council.

May 8, 1895.

TENDERS are invited for the supply of about 200 Tons of best screened COAL or NUTS, and 200 Tons of good SLACK for Twelve Months from June 1.

S. G. TULK, Proprietor, Builth Gas and Coke Works, BUILTH WELLS.

COAL TAR.

THE Aberdare Gas Company are pre- pared to receive TENDERS for their surplus TAR for One Year from the 1st of July next.

Coal Carbonized, about 4500 Tons per annum.

Sealed tenders, endorsed "Tar," to be sent to me not later than the 7th prox.

EVAN JONES,
Secretary and Manager.

TO COLLIERY OWNERS.

THE Gas Committee of the Corporation of Blackpool are prepared to receive TENDERS for the supply of about 25,000 Tons of COAL and CANNEL for the next Twelve Months from June 1.

Endorsed tenders to be addressed to the Chairman and sent in by the 25th day of May.

Specification and Form of Tender may be had from the undersigned.

JOHN CHEW,
Engineer.

Gas Office, Blackpool,
May 8, 1895.

TENDERS FOR GAS COAL.

THE Directors of the Cheltenham Gas- light and Coke Company are prepared to receive TENDERS for the supply of GAS COAL for Twelve Months from the 1st day of August next.

Full Particulars may be obtained from the undersigned, to whom tenders must be delivered on or before Thursday, the 6th day of June next.

The Directors do not bind themselves to accept the lowest or any tender.

By order,
R. O. PATERSON,
Engineer and Manager.

Gas-Works, Cheltenham,
May 15, 1895.

ST. ANNE'S-ON-THE-SEA GASLIGHT AND COKE COMPANY, LIMITED.

TENDERS FOR COAL.

THE Directors of the above Company are prepared to receive TENDERS for the supply of about 2000 tons of best screened GAS COAL, to be delivered in quantities as required from July 1, 1895, to June 30, 1896.

Sealed tenders, accompanied by Name and Analysis of Coal, and endorsed "Tender for Coal," to be sent to the undersigned not later than the 30th of May inst.

The lowest or any tender not necessarily accepted.

WILLIAM H. NUTTER,
Secretary and Manager.

Gas Offices, St. Anne's-on-the-Sea,
May 4, 1895.

ST. ANNE'S-ON-THE-SEA GASLIGHT AND COKE COMPANY, LIMITED.

TAR AND AMMONIACAL LIQUOR.

THE Directors of the above Company are prepared to receive OFFERS for the surplus TAR and LIQUOR produced at their Works for One Year commencing June 1, 1895.

Coal carbonized, about 2000 Tons.

Sealed tenders, endorsed "Tar and Liquor," to be sent to me not later than May 30 inst.

The highest or any tender not necessarily accepted.

WILLIAM H. NUTTER,
Secretary and Manager.

Gas Offices, St. Anne's-on-the-Sea,
May 4, 1895.

LEEK URBAN DISTRICT COUNCIL.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas Committee of the above Council invite TENDERS for the supply of best screened GAS COAL NUTS and CANNEL for One Year from the 1st of July next, to be delivered at Leek Station on the North Staffordshire Railway, at such times and in such quantities as may be required.

Further Particulars and Forms of Tender may be obtained from the undersigned.

Sealed and endorsed tenders, addressed to the Chairman of the Gas Committee, to be delivered at the Town Hall, Leek, by Four o'clock in the afternoon of Monday, the 27th of May inst.

The lowest or any tender will not necessarily be accepted.

By order of the Council,
C. HENSHAW,
Clerk.

Town Hall, Leek,
May 7, 1895.

DUKINFIELD URBAN DISTRICT COUNCIL.

TENDERS FOR GAS COAL.

THE Gas Committee of the above Council require TENDERS for 6000 Tons of freshgot screened GAS COAL, delivered at the Gas-Works or at the Sidings of the L. & N.W. or M. S. & L. Railway (Dog Lane) in Dukinfield. Of the above quantity 4000 Tons are to be delivered before the end of August next; and the remaining 2000 Tons in equal monthly quantities ending the 30th of June, 1896.

The Committee will not be bound to accept any tender, nor will any offer be considered except for the best screened Gas Coal.

Tenders, endorsed "Coal," to be here by Noon of Thursday, the 23rd inst., directed to Mr. Councillor Halstead, the Chairman of the Committee.

Any further Information may be had from

HARRISON VEEVERS, C.E.,
Engineer and Secretary.

King Street, Dukinfield,
May 6, 1895.

MARKET HARBOROUGH GASLIGHT AND COKE COMPANY.

THE Directors of the above Company invite TENDERS for the supply of about 3000 Tons of fresh wrought GAS COAL or NUTS.

Sealed tenders, endorsed "Coal," to be sent to the Chairman not later than the 30th inst.

Further Particulars from the undersigned.

J. FRYER,
Manager.

GAS COAL.

THE Gas Department of the Cockermouth Urban District Council invite TENDERS for the supply of GAS COAL required during Twelve Months ending June 30, 1896.

Endorsed tenders to be addressed to the Chairman of the Gas Committee, Gas-Works, Cockermouth, not later than the 27th of May.

Further Particulars on application to the undersigned.

ER W. SMITH,
Gas Manager.

BOROUGH OF NELSON.
(GAS DEPARTMENT.)

THE Gas Committee of the above Corporation invite TENDERS for 500 (each) 3-inch and 4-inch CAST-IRON PIPES.

Forms of Tender may be obtained from Mr. W. Foster, Engineer.

Sealed tenders, endorsed "Pipes," to be sent to the undersigned on or before the 29th day of May, 1895.

By order,
R. M. PRESCOTT,
Town Clerk.

Town Hall, Nelson,
May 15, 1895.

NEEDHAM MARKET GAS COMPANY.

TENDERS FOR COAL.

THE Directors of the Needham Market Gas Company are prepared to receive TENDERS for the supply of 170 Tons of best GAS COAL, to be delivered at Needham Market Station in such quantities as may be required during the Twelve Months ending June 30, 1896.

Tenders, specifying the name of Coal to be supplied, to be delivered to me on or before June 1, 1895.

MYLES GILBERT,
Secretary.

Needham Market,
May 18, 1895.

TENDERS FOR GAS COAL, LIME, ETC.

THE Directors of the Oakengates and St. George's Gas Company invite TENDERS for the supply of 1600 Tons of the best screened GAS COAL, delivered free at the Oakengates Station, in such quantities as may be required for One or Two Years between June 30, 1895, and June 30, 1896 or 1897.

Tenders, endorsed, and accompanied by an Analysis of the Coal offered, to be sent to the Manager on or before June 17, 1895.

TENDERS also invited for the supply of LIME, and the purchase of TAR and AMMONIACAL LIQUOR for One Year.

The Directors do not bind themselves to accept any tender.

GEO. PARKER,
Manager.

May 17, 1895.

MATLOCK AND DISTRICT GAS COMPANY, LIMITED.

SULPHURIC ACID.

THE Directors of the above Company are prepared to receive TENDERS for the supply of about 30 Tons of SULPHURIC ACID for the Manufacture of Sulphate of Ammonia for One Year from the 30th of June, 1895.

Further Particulars may be had on application to Mr. T. Brown, Manager, Gas-Works, Matlock.

Sealed tenders, endorsed, to be delivered to me the undersigned on or before Wednesday, June 12, 1895.

ROBERT HALL,
Secretary.

Gas Office, Crown Buildings, Matlock,
May 18, 1895.

TIVERTON CORPORATION.

TENDERS FOR COAL.

THE Lighting Committee are prepared to receive TENDERS for GAS COAL, required at the Tiverton Gas-Works for One, Two, or Three Years.

Further Particulars and Form of Tender may be obtained on application to the undersigned.

Sealed tenders, addressed to Mr. C. M. Hole, Town Clerk, and endorsed "Tender for Gas Coal," must be sent in on or before the 8th day of June next.

WM. LITTLEWOOD
Manager.

Gas-Works, Tiverton,
May 17, 1895.

THE URBAN DISTRICT COUNCIL OF SMETHWICK.

PAINTING GASHOLDERS, ETC.

THE Gas Committee invite Tenders for PAINTING Gasholders, Purifiers, Condensers, Washers, Scrubbers, and other Ironwork in accordance with the Specification, of which copies may be obtained from Mr. B. W. Smith, the Engineer at the Gas-Works.

The Contractor will be required to pay the standard rate of wages as recognized in the district.

Sealed tenders, endorsed "Tender for Painting Ironwork," addressed to the Chairman of the Gas Committee, to be delivered to me at the Public Buildings, not later than Tuesday morning, the 28th inst.

By order,
W. J. STURGES,
Secretary.

Public Buildings, Smethwick,
May 16, 1895.

COAL CONTRACT.

THE Directors of the Hexham Gas Company are prepared to receive TENDERS for the supply of about 2500 Tons of unscreened GAS COAL, delivered at Hexham Station as directed, during the Year ending June 30, 1896.

Tenders, with Analysis of Coal and Name of Pit at which it is raised, to be forwarded to the undersigned not later than the 6th of June.

HERBERT LEES,
Secretary and Manager.

Gas-Works, Hexham,
May 15, 1895.

THE Directors of the Kildwick Parish Gas Company invite TENDERS for the supply of the whole or part of 3000 Tons of best screened GAS COAL or NUTS, to be delivered free at Kildwick, during the Twelve Months ending June 30, 1896.

The Coal to be delivered at such times and in such quantities as the Manager may direct.

Tenders to be sent in not later than June 7, 1895.

The lowest or any tender not necessarily accepted.

FRED. H. PICKLES,
Manager and Secretary.

Gas-Works, Kildwick,
May 10, 1895.

TO BOILER MAKERS.

THE Directors of the Dover Gaslight Company invite TENDERS for the construction and delivery, at their Buckland Works, of Two LANCASHIRE BOILERS.

Drawings and Specifications can be seen at the Office of Mr. T. N. Kirkham, 335, Mansion House Chambers, London, E.C.

Tenders, marked "Tender for Boilers," to be lodged at the Secretary's Office, 14, Snargate Street, Dover, on or before Saturday, the 1st day of June next.

The Directors do not bind themselves to accept the lowest or any tender.

G. FIELDING,
Secretary.

Gaslight Company, Dover.

DEVONPORT GAS AND COKE COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the Devonport Gas and Coke Company invite TENDERS for the supply of 16,000 Tons or 80.0 Tons (at their option) of unscreened (through-and-through) NEWCASTLE or DURHAM GAS COALS, to be shipped in such quantities and at such times as may be required, between the 1st of August, 1895, and the 31st of July, 1896.

The Cargoes to be discharged at the Tamar Wharf, Devonport.

Tenders may be quoted either c.i.f. or f.o.b., endorsed "Tender for Coals," addressed to the Chairman, Devonport Gas and Coke Company, Devonport.

Tenders to be sent in on or before the 3rd of June next.

Devonport, May 15, 1895.

BOROUGH OF MACCLESFIELD.

THE Gas Committee are prepared to receive TENDERS for the supply of the whole or part of 9500 Tons of the Best Screened GAS COALS and 2500 Tons of CANNEL, to be delivered free at Macclesfield, at such times and in such quantities as shall be ordered. Deliveries to commence on the 1st of August, 1895, and to be completed within a year.

Forms of Tender and Conditions may be had on application to the Engineer, Gas-Works, Macclesfield.

Tenders, sealed and endorsed, to be sent in not later than Saturday, the 8th day of June, 1895, addressed to the Chairman, Gas Committee, Town Hall, Macclesfield.

The Committee do not pledge themselves to accept the lowest or any tender.

W. FREDK. TAYLOR,
Town Clerk.

May 13, 1895.

CORPORATION OF LEICESTER.

COAL TENDERS.

THE Gas and Electric Lighting Committee of the above Corporation are prepared to receive TENDERS for the supply of COALS, COBBLES, or NUTS (about 120,000 Tons per annum), for One, Two, or Three Years ending May 31.

Particulars and Form of Tender can be obtained on application to the Engineer.

Tenders, addressed to Alderman Lennard, Chairman, and endorsed "Tender for Gas Coal," to be delivered at these Offices not later than Eleven o'clock a.m., on Saturday, the 8th of June next.

The Committee do not bind themselves to accept the lowest or any tender.

ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.

Gas Offices, Millstone Lane,
Leicester, May 15, 1895.

BRIERLEY HILL DISTRICT GASLIGHT COMPANY.

TENDERS FOR COAL.

THE Directors are prepared to receive TENDERS for the supply of 6000 Tons of GAS COAL, delivered to Brettell Lane or Round Oak Siding (G.W.R.), in such quantities as may be required from the 1st of July next to the 30th of June, 1896.

Tenders, stating price per ton (20 cwt.), delivered to the above-mentioned Stations, with latest Analytical Test, to be sent addressed to the Chairman of the Company, and marked "Tender for Coal," not later than the 24th inst.

The Directors reserve the right to accept tenders for the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender.

No Tender Forms issued.

By order,
HENRY M. JACKSON,
Secretary.

Board-Room, Gas-Works, Brierley Hill,
May 13, 1895.

WORTHING GAS COMPANY.

TENDERS are invited by the above Company for the surplus TAR and AMMONIACAL LIQUOR manufactured on the Company's Works, for a period of One, Two, or Three Years from the 1st of July next.

Approximate quantities: Tar, 60,000 gallons; Liquor, 150,000 gallons per annum.

Tenders to be sent to W. F. Verrall, Esq., Secretary, Chapel Road, Worthing, on or before Friday, the 31st inst., endorsed "Tender for Tar and Liquor."

W. A. WALKER,
Manager.

THE Directors of the Cranleigh Gas and Coke Company invite TENDERS for the supply of not less than 900 Tons of good GAS COAL, to be delivered free at Cranleigh Station (L.B. & S.C. Railway), when required, between July, 1895, and July, 1897.

Sealed tenders, endorsed "Coal," to be sent to the Secretary, on or before June 10, 1895.

The Directors do not bind themselves to accept the lowest or any tender.

No Tender Forms supplied.

By order,
H. J. HAYMAN,
Secretary.

Cranleigh,
May 14, 1895.

NEWCASTLE-UNDER-LYME CORPORATION.
(GAS DEPARTMENT.)

THE Gas Committee are prepared to receive OFFERS for the supply of about 8500 Tons of GAS COAL (Screened), BURGHY, Washed NUTS or Washed BEANS, for the Year ending May 31, 1896.

Delivery free at their Sidings at the Gas-Works.

Deliveries to be made in such quantities and at such times as the Manager may direct.

The Coal, Burghy, Washed Nuts, and Beans to be free from Bat, Bind, or Refuse.

Forms of Tender and Agreement to be had on application to the Manager.

The Committee do not bind themselves to accept the lowest or any tender.

Tenders, endorsed "Tender for Gas Coal," to be sent to the Town Clerk on or before the 25th of May, 1895.

W. WINSTANLEY, Assoc.M.Inst.C.E.,
Manager and Secretary.

TUNBRIDGE WELLS GAS COMPANY.

SALE OF £5000 4½ PER CENT. TUNBRIDGE WELLS GAS DEBENTURE STOCK.

MR. WM. ROPER begs to announce that he has been favoured with Instructions from the Directors of the Tunbridge Wells Gas Company, to SELL BY AUCTION at the Pump Room, Tunbridge Wells, on Friday, the 24th of May, 1895, at Four o'clock in the Afternoon precisely,

£5000 OF TUNBRIDGE WELLS GAS DEBENTURE STOCK,

entitled to Interest at the rate of 4½ per cent. per annum, payable Half Yearly, in—

3	Lots of	£500 each.
5	,,	£200 ,,
20	,,	£100 ,,
10	,,	£50 ,,

The Debenture Stock of the Company, with Interest thereon, is a charge upon the Undertaking of the Company prior to all Shares or Stock of the Company; and the Auctioneer confidently recommends this Stock to all those who are desirous of obtaining a safe Investment for Capital.

Further Particulars and Conditions of Sale may be had at the offices of Messrs. STONE, SIMPSON, AND SON, Solicitors, Church Road; the AUCTIONEER, 49, Mount Pleasant; and Mr. JOHN READ, the Secretary of the Company, 44, High Street, TUNBRIDGE WELLS.

NOTICE.

TO GAS ENGINEERS AND OTHERS.

MESSRS. CLAPHAM BROS., Limited, Keighley, Yorkshire, are no longer authorized to Manufacture my CONDENSER and WASHER-SCRUBBERS.

The above-named Gas Apparatus are erected and giving entire satisfaction at the following places: Neath, Lincoln, Sheffield, Ellesmere, Mountain Ash, Malden, Cullingworth, Montreal (Canada), Woodstock (South Africa), Cape Town (South Africa), &c.

These Appliances can now be obtained solely of the undersigned.

Winchester House, London, E.C. J. A. KELMAN.

TO EMPLOYERS, COMPANY DIRECTORS, ETC.

The LAW GUARANTEE & TRUST SOCIETY, LIMITED,

GUARANTEES FIDELITY.

Send for complete Prospectus, containing Balance-Sheet, Copy of Policy, &c., &c.

HEAD OFFICE:

49, CHANCERY LANE, LONDON, W.C.

HUNTER'S

OXIDE OF IRON.

JAMES HUNTER, MINER, AND SHIPPER OF NATURAL IRISH BOG ORE.

This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.

Samples and Prices on application.

11, BAY STREET, PORT GLASGOW.

Telegrams: "HUNTER, PORT GLASGOW."

Established 1872.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

THE SILICA FIRE-BRICK COMPANY,

OUGHTIBRIDGE, near SHEFFIELD,

MANUFACTURE

SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY

FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their

GREATER DURABILITY,

Strongly recommended where EXCESSIVE HEATS have to be maintained.

KENT'S THICK GAS COAL

RAISED AT

The Wharncliffe Woodmoor Colliery,

BARNSLEY.

Yield of Gas, nearly 12,000 *Cubic Feet per ton of Coal; and Illuminating Power nearly* 17½ *Candles.*

The following is a complete ANALYSIS made by Mr. R. O. PATERSON, C.E., Gas-Works, Cheltenham :—

Specific Gravity (Water 1). .	1·276
Weight of One Cubic Foot. .	79·700 lbs.

PROXIMATE ANALYSIS.

Moisture in Coal	2·68 per cent.
Volatile Matter.	35·60 ,,
Fixed Carbon	58·80 ,,
Sulphur	0·96 ,,
Ash.	1·96 ,,

COMMERCIAL ANALYSIS.

Gas per Ton of Coal	11,760 cub. feet.
Gas per Cubic Foot of Coal .	418 ,,
Illuminating Power	17·44 candles.
Value of One Cubic Foot in Sperm	418 grains.
Value per Ton of Coal in Sperm	703 lbs.
Coke per Ton of Coal . . .	1367 ,,
Coke	61·05 per cent.
Ash in Coke	3·21 ,,
Sulphur Eliminated with Volatile Products per Ton of Coal	9·4 lbs.
Sulphur in Coke per Ton of Coal	12 ,,
Ammoniacal Liquor per Ton of Coal	19·7 galls.
Tar per Ton of Coal	12·2 ,,

R. O. PATERSON, C.E.

Gas-Works, Cheltenham, 8th August, 1894.

For Price, &c., apply to the

Wharncliffe Woodmoor Colliery Co LIMITED,

BARNSLEY;

Or to Mr. W. H. HARVEY,

17, Old Queen Street, Westminster, S.W.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For prices, f.o.b. Ship or Delivered by Rail, apply to

THE WALLSEND & HEBBURN COAL COMPANY, LTD.
B Lombard Street,
NEWCASTLE-ON-TYNE.

W. RICHARDSON, Fitter.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS :—

Yield of Gas Per Ton. . 11,205 Cubic Feet.
Illuminating Power, 16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality) 13¾ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE, 2500 TONS.

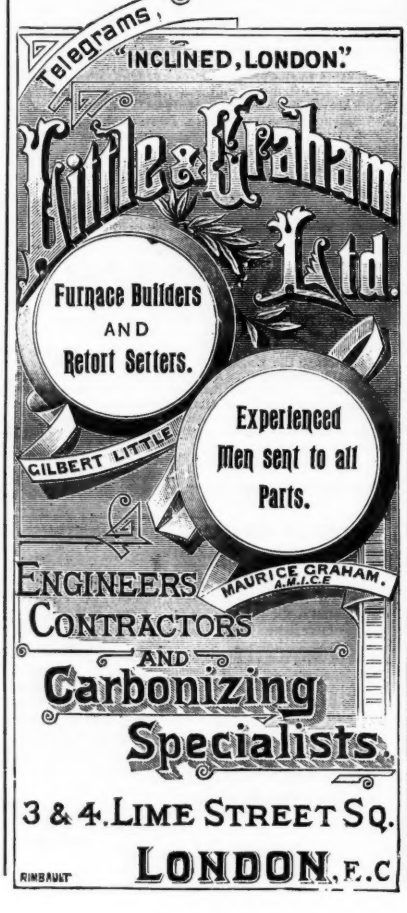
RESULTS OF DIFFERENT ANALYSES :—

Yield of Gas Per Ton. . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . 13½ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar . . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 94½ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COALFIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.



NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY, LIMITED,

NEWBATTLE COLLIERIES,

DALKEITH, N.B.

LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,

COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO

S. J. DITCHFIELD,

SEAHAM HARBOUR, COUNTY OF DURHAM.

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON AND COAL COMPANY, Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

The Analysis made by Messrs. J. and H. T. Pattinson, Public Analysts for Northumberland, gives 10,500 cubic feet of Gas per ton, with an Illuminating Power of 16·3 Candles and 67·3 per cent. of Coke. The following is a Working Analysis made of these Coals by the Tudhoe and Sunderland Bridge Gas Company:—

[COPY.]

TUDHOE AND SUNDERLAND BRIDGE GAS COMPANY.
Tudhoe Gas-Works,
Spennymoor,
8th June, 1893.

Messrs. The

WEARDALE IRON & COAL COMPANY, LTD.

GENTLEMEN,

For the last two months we have used your **THORNLEY GAS COAL** exclusively at these gas-works; and I have pleasure in herewith giving you the actual results obtained during the trial.

Yield of Gas per ton: 10,300 cubic feet.
Yield of Coke: 13½ cwt.
Illuminating Power of Gas, average of a series of tests, **17 Sperm Candles.**
The Coke was of excellent quality.
The following is a complete ultimate Analysis of the Coal.

	Per Cent.
Carbon	83·128
Hydrogen	5·116
Oxygen	7·401
Nitrogen	0·585
Sulphur	0·620
Ash	3·130
Water	0·020
	100·000

Analysis of the Coke.

Carbon	93·31
Sulphur	0·61
Ash	5·00
Moisture	1·08
	100·00

I am, Gentlemen,
Yours truly,
A. B. COWAN,
Manager.

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.

QUAYSIDE, NEWCASTLE-ON-TYNE.

INCANDESCENT GAS-LIGHT

NOTICE.

The Incandescent Gas-Light Company, Limited, Hereby Give Notice, that Actions will be brought to restrain Infringements of their Patents against all persons directly or indirectly taking part in making, using, or selling apparatus for Incandescent Gas Lighting called "De Mare System." All persons taking part in the Infringement of the above-mentioned Patents will be liable not only to an Injunction and Damages, but to costs as between Solicitor and Client; the validity of such Patents having been established, and a certificate to that effect granted by the Honourable Mr. Justice Romer.

(Signed) FAITHFULL AND OWEN,
11, Victoria Street, S.W.,
Solicitors to the Incandescent Gas-Light Company, Limited.

NOTICE.

The Incandescent Gas-Light Company, Limited, Hereby Give Notice, that they only supply their Mantles subject to the following express Conditions, which are printed and pasted on each box:—

> "The Incandescent Gas-Light Company, Limited, in supplying the Mantle contained in this box, grant a Limited License to the purchaser to sell or use the same on the express condition that neither the purchaser nor any other person into whose hands the same may come shall use or sell the said Mantle except in connection, or for use, with Burners sold or supplied by the Company; any other sale or use will amount to infringement of the Company's Patents. The Company supply Mantles for the purpose of renewals at the nominal price of 1s. 3d., subject to the Conditions and Limitations above set forth."

In the case of *The Incandescent Gas-Light Company, Limited v. Cantelo*, Mr. Justice Wills upheld the Validity of these Conditions and Limited License; and, in the course of his Judgment, said:—

> "The patentee has the sole right of using and selling the articles; and he may prevent anybody from dealing with them at all. Inasmuch as he has the right to prevent people from using them or dealing in them at all, he has the right to do the lesser thing—that is to say, to impose his own conditions. It does not matter how unreasonable or how absurd the conditions are. It does not matter what they are if he says at the time when the purchaser proposes to buy, or the person proposes to take a license: 'Mind I only give you this license on this condition;' and the purchaser is free to leave it or take it as he likes. If he takes it, he must be bound by the condition."

In the case of *The Incandescent Gas-Light Company v. Hirschfeld and Others*, the Honourable Mr. Justice Romer certified that the Validity of the Plaintiffs' Patents was established. Infringers in future will be liable to costs as between Solicitor and Client.

(Signed) FAITHFULL AND OWEN,
Solicitors for the Incandescent Gas-Light Company, Limited.

COKE-BREAKERS,

PRICES REDUCED.

(THOMAS & SOMERVILLE'S PATENT.)

New Design, with two Cutting Rollers, making less Breeze than their old pattern.

GEORGE WALLER & CO.,
PARK STREET, SOUTHWARK, E.C.,
And at STROUD, GLOUCESTERSHIRE.

Complete Automatic Coal-Stores, Retort-Houses, and Coke Yards.

Retort Mouthpieces and Furnace Fittings.

LABORLESS WORK
In 1895.

ENGINEERS AND MANAGERS

Making preparations to adopt

SELF-ACTING SYSTEMS OF CARBONIZING

In 1895,

are cordially invited to call and inspect our latest Designs of Automatic Coal and Coke Handling and Charging Machinery.

We send skilled Draughtsmen to get Particulars for Detail Plans.

Address:—
NEW CONVEYOR CO., LTD.,
3 & 4, LIME STREET SQUARE, LONDON, E.C.

ALFRED WILLIAMS & CO.
(MATTHEW MILDRED)
71, 72 & 73, BANK SIDE,
SOUTHWARK, S.E.
UNIVERSAL PROVIDERS
FOR
GAS, WATER, & SEWAGE WORKS,
ENGINEERS & CONTRACTORS
FOR THE ERECTION OF COMPLETE GAS AND WATER WORKS, AND FOR RENEWALS AND EXTENSIONS OF EVERY DESCRIPTION.
PLANS & ESTIMATES ON APPLICATION.
MAIN LAYING AND RETORT SETTING.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

CANNEL & COAL.

TYNE

BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to

THOS. W. DANCE & SONS,
COAL OWNERS, NEWCASTLE-ON-TYNE;
OR
E. FOSTER & CO.,
21, JOHN STREET, ADELPHI, LONDON, W.C.

T. B. KITTEL, SHEFFIELD.
CONTRACTS FOR SUPPLIES OF ANY OF THE PRINCIPAL
ENGLISH & SCOTCH CANNELS.
REAL SILKSTONE GAS COAL
ANALYSIS AND PRICES ON APPLICATION.
T. B. KITTEL, SHEFFIELD.

PIPES, 2-in. to 8-in. PIPES, 2-in. to 8-in. PIPES.

MONIER-WILLIAMS & Co.
IRONFOUNDERS,
MIDDLESBROUGH.

THOMAS TURTON AND SONS, LIMITED,

SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
London Office:
90, CANNON STREET, E.C.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.
Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton	10,500	Cubic Feet.
Illuminating Power	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Bombay Gas Company, San Paulo Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the

HARTON COAL COMPANY,
LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON,
FITTER.

CLAYTON SON & Co., LTD
MAKERS OF LEEDS
LARGEST GASHOLDER IN WORLD
ALSO THE LARGEST METAL TANK THE
See Advertisement last week, also next week
MAKERS OF RETORT-LIDS OF ALL FORMS & SHAPES BY SPECIAL HYDRAULIC MACHINERY

SULPHATE OF AMMONIA SATURATORS.

JOSEPH TAYLOR & CO.,
Central Plumbing Works, Town Hall Square,
BOLTON.

Practical Makers of all kinds of Saturators, and Specialists in every description of Lead Work required in connection with Sulphate Plants.
Special attention to Repairs.
Improved Lead-Burning Machines, Sulphate Bagging Machines, Copper Scoops, &c.

HIGHEST REFERENCES ON APPLICATION.

LOW MOOR BLACK BED GAS COAL.

YIELD OF GAS PER TON . 10,375 CUBIC FEET.
ILLUMINATING POWER . 17·50 SPERM CANDLES.
COKE. . . . . 75 PER CENT.

Prices, f.o.r. or f.o.b., on application to
GEORGE & JOHN HAIGH,
RAVENS LODGE AND CONYERS' COLLIERIES,
DEWSBURY.

A TRIAL IS RESPECTFULLY SOLICITED.

TROTTER, HAINES, & CORBETT,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

"CANNELINE" FOR ENRICHING COAL GAS.

Superior to the very Volatile Hydrocarbons; requiring only a simple apparatus, at quite a nominal cost.

Coal Gas enriched by "CANNELINE" shows conclusively this Hydrocarbon is vastly superior to all other Enriching Agents, including Cannel Coal.

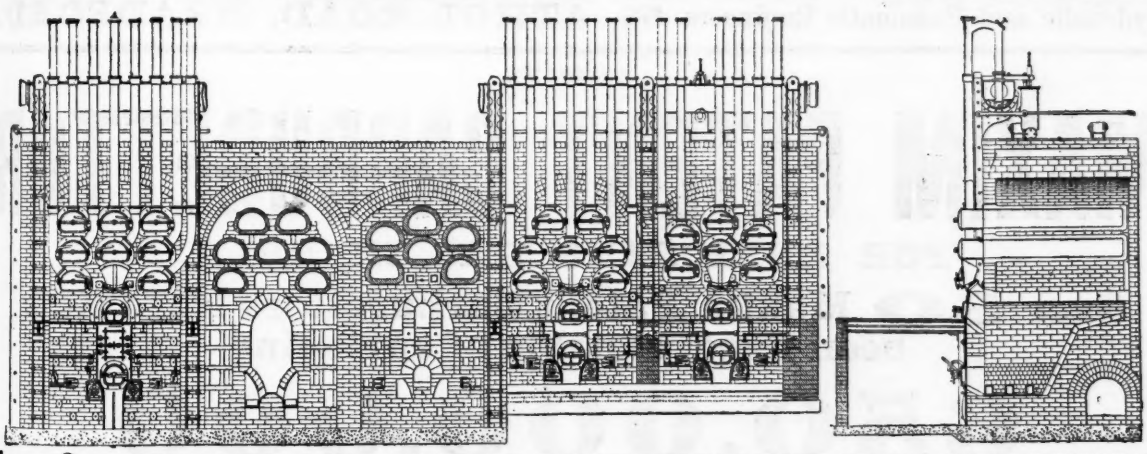
For all Particulars, apply to

S. BOWLEY & SON, Wellington Works, BATTERSEA BRIDGE, LONDON.

JOHN BROWN & CO., LTD., SHEFFIELD,
Proprietors of
ALDWARKE MAIN CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.
ALDWARKE MAIN GAS COAL

Analysis: 12,600 feet of 19-candle gas per ton.
Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.
Telegrams: "ATLAS SHEFFIELD."

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS, CARBONIZING FROM 18 TO 24 CWT. OF ENGLISH AND 21 TO 26 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

Full Particulars may be had on application to the Patentee's Agents: **Messrs. JONAS DRAKE AND SON**, Retort Setters and General Carbonizing Engineers, Ovenden, Halifax, Yorkshire, Sole Agents for England, Wales, and Foreign Countries; **C. M. HAMILTON**, Retort Setter and Contractor, 5, Stuart Street, Shawlands, Glasgow, Agent for Scotland and Ireland; and to the Principal Agent, **R. F. HISLOP** (Son of Patentee), General Constructing and Carbonizing Engineer, Gas-Works, Paisley, N.B.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non* TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

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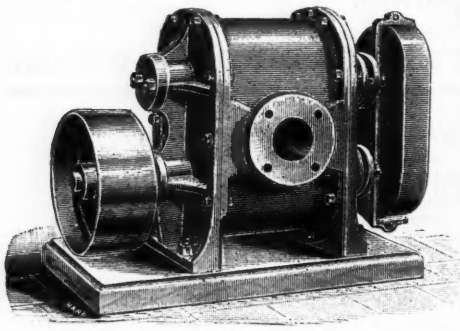

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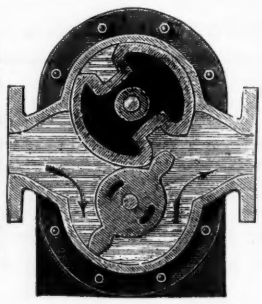

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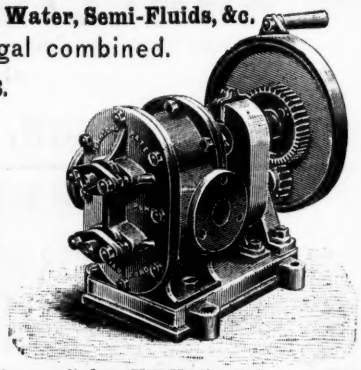

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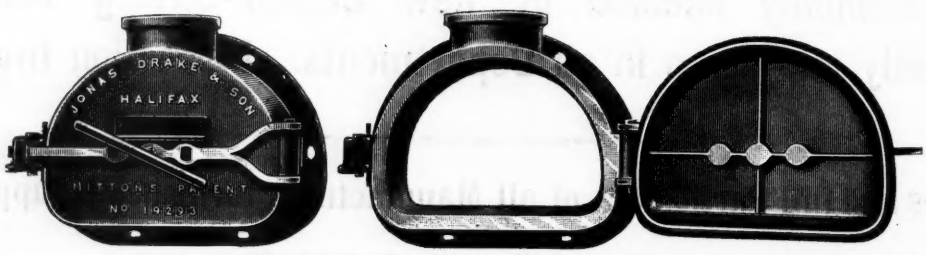

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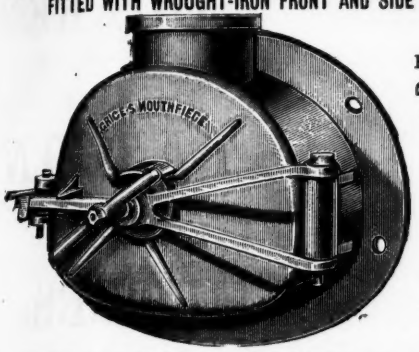

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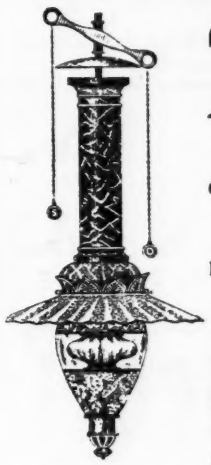

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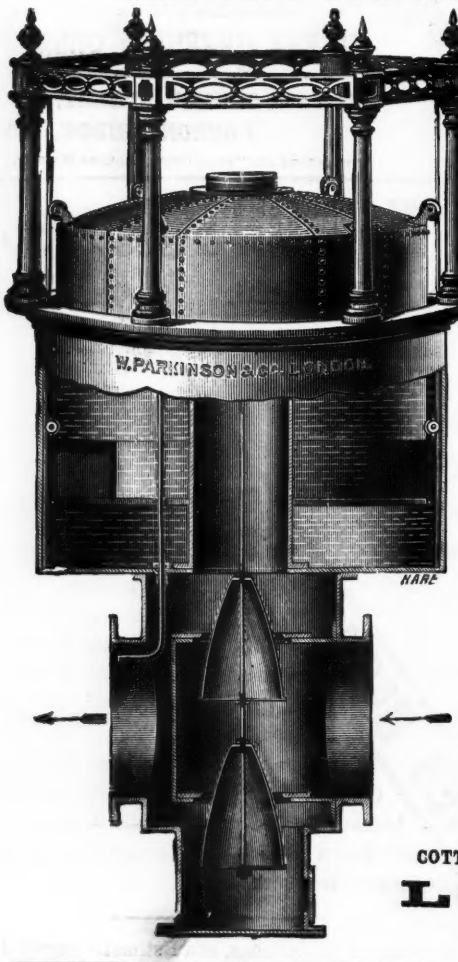

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[See also Advt. p. 1056.

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